Shark® 100/100T/100B/100BT/ 50/50B

Multifunction Power & Energy Meters/Transducers

SHARK® 50
Multifunction Meter
0.5% Class with Modbus

SHARK® 50B
Meter with BACnet MS / TP

SHARK® 100B
Meter with BACnet / IP

SHARK® 100
Multifunction Meter
0.2% Class with
Modbus + DNP 3.0

SHARK® 100T
Multifunction Transducer
with Modbus + DNP 3.0

SHARK® 100BT
Transducer with
BACnet / IP

Installation & Operation Manual
V.1.27
March 10, 2015

Electro Industries/GaugeTech
The Leader In Power Monitoring and Smart Grid Solutions

1800 Shames Drive, Westbury, NY 11590 Tel: (516) 334-0870 Fax: (516) 338-4741 Email: sales@electroind.com

www.electroind.com

This page intentionally left blank.

Shark® 100/100T/100B/100BT/50/50B Meter Installation and Operation Manual
Version 1.27

Published by:

Electro Industries/GaugeTech

1800 Shames Drive

Westbury, NY 11590

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or information storage or retrieval systems or any future forms of duplication, for any purpose other than the purchaser's use, without the expressed written permission of Electro Industries/GaugeTech.

© 2015 Electro Industries/GaugeTech

Nexus® and Shark® are registered trademarks of Electro Industries/GaugeTech. The distinctive shape, style, and overall appearances of all Shark® meters are trademarks of Electro Industries/GaugeTech. Communicator EXT™ is a trademark of Electro Industries/GaugeTech.

Windows® is a registered trademark of Microsoft Corporation in the United States and/or other countries.

BACnet® is a registered trademark of ASHRAE.
Modbus® is a registered trademark of Schneider Electric, licensed to the Modus Organization, Inc.

This page intentionally left blank.

Customer Service and Support

Customer support is available 9:00 am to 4:30 pm, Eastern Standard Time, Monday through Friday. Please have the model, serial number and a detailed problem description available. If the problem concerns a particular reading, please have all meter readings available. When returning any merchandise to EIG, a return materials authorization number is required. For customer or technical assistance, repair or calibration, phone 516-334-0870 or fax 516-338-4741.

Product Warranty

Electro Industries/GaugeTech warrants all products to be free from defects in material and workmanship for a period of four years from the date of shipment. During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, fax or call our customer-support department. You will receive prompt assistance and return instructions. Send the instrument, transportation prepaid, to EIG at 1800 Shames Drive, Westbury, NY 11590. Repairs will be made and the instrument will be returned.

This warranty does not apply to defects resulting from unauthorized modification, misuse, or use for any reason other than electrical power monitoring. The Shark® 100/100T/100B/100BT/50/50B meter is not a user-serviceable product.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ELECTRO INDUSTRIES/GAUGETECH SHALL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING FROM ANY AUTHORIZED OR UNAUTHORIZED USE OF ANY ELECTRO INDUSTRIES/GAUGETECH PRODUCT. LIABILITY SHALL BE LIMITED TO THE ORIGINAL COST OF THE PRODUCT SOLD.

Use of Product for Protection

Our products are not to be used for primary over-current protection. Any protection feature in our products is to be used for alarm or secondary protection only.

Statement of Calibration

Our instruments are inspected and tested in accordance with specifications published by Electro Industries/GaugeTech. The accuracy and a calibration of our instruments are traceable to the National Institute of Standards and Technology through equipment that is calibrated at planned intervals by comparison to certified standards. For optimal performance, EIG recommends that any meter, including those manufactured by EIG, be verified for accuracy on a yearly interval using NIST traceable accuracy standards.

Disclaimer

The information presented in this publication has been carefully checked for reliability; however, no responsibility is assumed for inaccuracies. The information contained in this document is subject to change without notice.

This symbol indicates that the operator must refer must to an important WARNING or CAUTION in the operating instructions. Please see Chapter 4 for important safety information regarding installation and hookup of the Shark® 50/50B/100/100T/100B/100BT meter.

Dans ce manuel, ce symbole indique que l'opérateur doit se référer à un important AVERTISSEMENT ou une MISE EN GARDE dans les instructions opérationnelles. Veuillez consulter le chapitre 4 pour des informations importantes relatives à l'installation et branchement du compteur.

The following safety symbols may be used on the meter itself:

Les symboles de sécurité suivante peuvent être utilisés sur le compteur même:

This symbol alerts you to the presence of high voltage, which can cause dangerous electrical shock.

Ce symbole vous indique la présence d'une haute tension qui peut provoquer une décharge électrique dangereuse.

This symbol indicates the field wiring terminal that must be connected to earth ground before operating the meter, which protects against electrical shock in case of a fault condition.

Ce symbole indique que la borne de pose des canalisations in-situ qui doit être branchée dans la mise à terre avant de faire fonctionner le compteur qui est protégé contre une décharge électrique ou un état défectueux.

This symbol indicates that the user must refer to this manual for specific WARNING or CAUTION information to avoid personal injury or damage to the product.

Ce symbole indique que l'utilisateur doit se référer à ce manuel pour AVERTISSEMENT ou MISE EN GARDE l'information pour éviter toute blessure ou tout endommagement du produit.

About Electro Industries/GaugeTech (EIG)

Founded in 1975 by engineer and inventor Dr. Samuel Kagan, Electro Industries/GaugeTech changed the face of power monitoring forever with its first breakthrough innovation: an affordable, easy-to-use AC power meter.

Forty years since its founding, Electro Industries/GaugeTech, the leader in power monitoring and control, continues to revolutionize the industry with the highest quality, cutting edge power monitoring and control technology on the market today. An ISO 9001:2000 certified company, EIG sets the industry standard for advanced power quality and reporting, revenue metering and substation data acquisition and control. EIG products can be found on site at mainly all of today's leading manufacturers, industrial giants and utilities.

EIG products are primarily designed, manufactured, tested and calibrated at our facility in Westbury, New York.

This page intentionally left blank.

Table of Contents

Customer Service and Support	iii
Product Warranty	iii
Use of Product for Protection	iv
Statement of Calibration	iv
Disclaimer	iv
About Electro Industries/GaugeTech (EIG)	v
1: Three-Phase Power Measurement	**1-1**
1.1: Three-Phase System Configurations	1-1
1.1.1: Wye Connection	1-1
1.1.2: Delta Connection	1-4
1.1.3: Blondel's Theorem and Three Phase Measurement	1-6
1.2: Power, Energy and Demand	1-8
1.3: Reactive Energy and Power Factor	1-12
1.4: Harmonic Distortion	1-14
1.5: Power Quality	1-17
2: Meter Overview and Specifications	**2-1**
2.1: Hardware Overview	2-1
2.1.1: Voltage and Current Inputs	2-4
2.1.2: Model Number plus Option Numbers	2-5
2.1.3: V-Switch™ Key Technology	2-7
2.1.4: Measured Values	2-9
2.1.5: Utility Peak Demand	2-10

2.2: Specifications	2-10
2.3: Compliance	2-16
2.4: Accuracy	2-17
3: Mechanical Installation	**3-1**
3.1: Introduction	3-1
3.2: ANSI Installation Steps	3-4
3.3: DIN Installation Steps	3-5
3.4: Shark® 100T Transducer Installation	3-6
4: Electrical Installation	**4-1**
4.1: Considerations When Installing Meters	4-1
4.2: CT Leads Terminated to Meter	4-4
4.3: CT Leads Pass Through (No Meter Termination)	4-5
4.4: Quick Connect Crimp-on Terminations	4-6
4.5: Voltage and Power Supply Connections	4-7
4.6: Ground Connections	4-7
4.7: Voltage Fuses	4-7
4.8: Electrical Connection Diagrams	4-8
4.9: Extended Surge Protection for Substation Instrumentation	4-21
5: Communication Installation	**5-1**
5.1: Shark® 100/50 Meter Serial Based Communication	5-1
5.1.1: IrDA Port (Com 1)	5-2
5.1.2: RS485/KYZ Output Com 2 (485P Option)	5-3
5.1.2.1: Using the Unicom 2500	5-7

5.2: Configuring the Shark® 100 - INP10 Ethernet Connection 5-8

5.2.1: Setting up the Host PC to Communicate with the Shark® 100 - INP10 meter 5-9

5.2.1.1: Configuring the Host PC's Ethernet Adapter through Windows© 5-9

5.2.2: Setting up the Shark® 100 - INP10 Meter for Ethernet Communication 5-11

5.2.2.1: Configuring the Shark® 100 - INP10 Meter's Ethernet Connection on the Host Computer 5-12

5.2.2.2: Resetting the Ethernet Card (INP10) 5-14

5.3: Shark® 50B/100B Meter Ethernet Configuration 5-14

6: Using the Shark® 100/50 Meter 6-1

6.1: Programming the Shark® 100/100B/50/50B Meter Using the Faceplate 6-1

6.1.1: Understanding Meter Face Elements 6-1

6.1.2: Understanding Meter Face Buttons 6-2

6.2: Using the Front Panel 6-3

6.2.1: Understanding Startup and Default Displays 6-3

6.2.2: Using the Main Menu 6-4

6.2.3: Using Reset Mode 6-5

6.2.4: Entering a Password 6-6

6.2.5: Using Configuration Mode 6-7

6.2.5.1: Configuring the Scroll Feature 6-9

6.2.5.2: Configuring CT Setting 6-10

6.2.5.3: Configuring PT Setting 6-11

6.2.5.4: Configuring Connection Setting 6-13

6.2.5.5: Configuring Communication Port Setting 6-13

6.2.6: Using Operating Mode 6-15

6.3: Understanding the % of Load Bar 6-16

6.4: Performing Watt-Hour Accuracy Testing (Verification) 6-17

6.5: Programming the Transducer or Meter Using Software 6-19

6.5.1: Accessing the Transducer/Meter in Default Communication Mode (RS485 Communication) 6-19

6.5.2: Connecting to the Transducer/Meter through Communicator EXT™ Software 6-20

6.5.3: Device Profile Settings 6-24

7: Using the Shark® 100B Meter 7-1

7.1: Introduction 7-1

7.1.1: About BACnet 7-1

7.2: Shark® 100B Meter's BACnet Objects 7-2

7.3: Configuring the Shark® 100B Meter 7-5

7.4: Using the Shark® 100B Meter's Web Interface 7-12

7.5: Using the Shark® 100B in a BACnet Application 7-18

8: Using the Shark® 50B Meter 8-1

8.1: Introduction 8-1

8.2: Shark® 50B Meter's BACnet Objects 8-1

8.3: Configuring the Shark® 50B Meter 8-3

8.4: Using the Shark® 50B Meter's Web Interface 8-10

8.5: Using the Shark® 50B in a BACnet Application 8-16

A: Shark® 100/50 Meter Navigation Maps **A-1**

A.1: Introduction A-1

A.2: Navigation Maps (Sheets 1 to 4) A-1

B: Shark® 100 and 50 Meter Modbus Maps **B-1**

B.1: Introduction B-1

B.2: Modbus Register Map Sections B-1

B.3: Data Formats B-1

B.4: Floating Point Values B-2

B.5: Modbus Register Map B-3

C: Shark® 100 Meter DNP Map **C-1**

C.1: Introduction C-1

C.2: DNP Mapping (DNP-1 to DNP-2) C-1

D: DNP 3.0 Protocol Assignments **D-1**

D.1: DNP Implementation D-1

D.2: Data Link Layer D-2

D.3: Transport Layer D-3

D.4: Application Layer D-3

D.4.1: Object and Variation D-4

D.4.1.1: Binary Output Status (Obj. 10, Var. 2) D-5

D.4.1.2: Control Relay Output Block (Obj. 12, Var. 1) D-6

D.4.1.3: 32-Bit Binary Counter Without Flag (Obj. 20, Var. 5) D-7

D.4.1.4: 16-Bit Analog Input Without Flag (Obj. 30, Var. 4) D-7

D.4.1.5: Class 0 Data (Obj. 60, Var. 1) D-13

D.4.1.6: Internal Indications (Obj. 80, Var. 1) D-13

E: Using the USB to IrDA Adapter CAB6490 E-1

E.1: Introduction E-1

E.2: Installation Procedures E-1

1: Three-Phase Power Measurement

This introduction to three-phase power and power measurement is intended to provide only a brief overview of the subject. The professional meter engineer or meter technician should refer to more advanced documents such as the EEI Handbook for Electricity Metering and the application standards for more in-depth and technical coverage of the subject.

1.1: Three-Phase System Configurations

Three-phase power is most commonly used in situations where large amounts of power will be used because it is a more effective way to transmit the power and because it provides a smoother delivery of power to the end load. There are two commonly used connections for three-phase power, a wye connection or a delta connection. Each connection has several different manifestations in actual use.

When attempting to determine the type of connection in use, it is a good practice to follow the circuit back to the transformer that is serving the circuit. It is often not possible to conclusively determine the correct circuit connection simply by counting the wires in the service or checking voltages. Checking the transformer connection will provide conclusive evidence of the circuit connection and the relationships between the phase voltages and ground.

1.1.1: Wye Connection

The wye connection is so called because when you look at the phase relationships and the winding relationships between the phases it looks like a Y. Figure 1.1 depicts the winding relationships for a wye-connected service. In a wye service the neutral (or center point of the wye) is typically grounded. This leads to common voltages of 208/120 and 480/277 (where the first number represents the phase-to-phase voltage and the second number represents the phase-to-ground voltage).

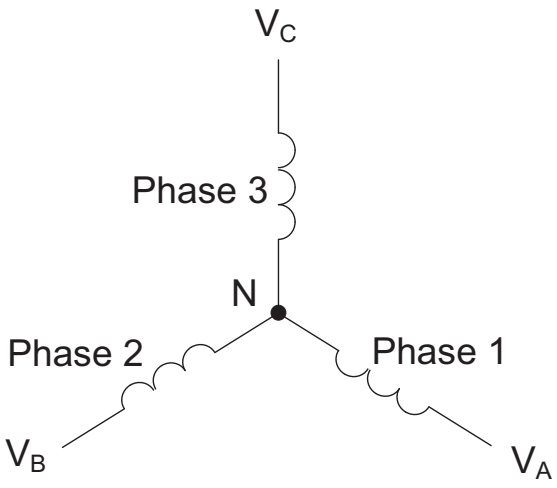


Figure 1.1: Three-phase Wye Winding

The three voltages are separated by 120° electrically. Under balanced load conditions the currents are also separated by 120°. However, unbalanced loads and other conditions can cause the currents to depart from the ideal 120° separation. Three-phase voltages and currents are usually represented with a phasor diagram. A phasor diagram for the typical connected voltages and currents is shown in Figure 1.2.

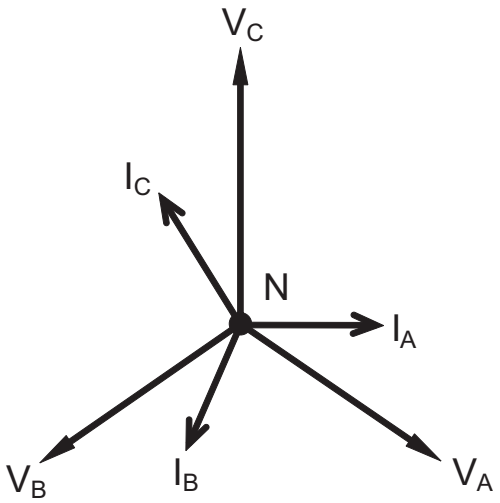


Figure 1.2: Phasor Diagram Showing Three-phase Voltages and Currents

The phasor diagram shows the 120^{o} angular separation between the phase voltages. The phase-to-phase voltage in a balanced three-phase wye system is 1.732 times the phase-to-neutral voltage. The center point of the wye is tied together and is typically grounded. Table 1.1 shows the common voltages used in the United States for wye-connected systems.

Phase to Ground Voltage	Phase to Phase Voltage
120 volts	208 volts
277 volts	480 volts
2,400 volts	4,160 volts
7,200 volts	12,470 volts
7,620 volts	13,200 volts

Table 1: Common Phase Voltages on Wye Services

Usually a wye-connected service will have four wires: three wires for the phases and one for the neutral. The three-phase wires connect to the three phases (as shown in Figure 1.1). The neutral wire is typically tied to the ground or center point of the wye.

In many industrial applications the facility will be fed with a four-wire wye service but only three wires will be run to individual loads. The load is then often referred to as a delta-connected load but the service to the facility is still a wye service; it contains four wires if you trace the circuit back to its source (usually a transformer). In this type of connection the phase to ground voltage will be the phase-to-ground voltage indicated in Table 1, even though a neutral or ground wire is not physically present at the load. The transformer is the best place to determine the circuit connection type because this is a location where the voltage reference to ground can be conclusively identified.

1.1.2: Delta Connection

Delta-connected services may be fed with either three wires or four wires. In a three-phase delta service the load windings are connected from phase-to-phase rather than from phase-to-ground. Figure 1.3 shows the physical load connections for a delta service.

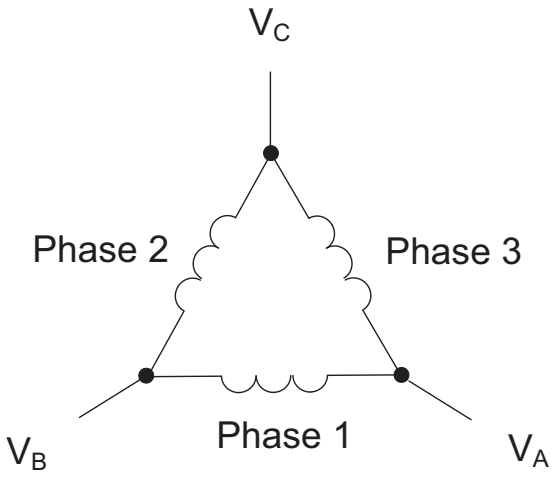


Figure 1.3: Three-phase Delta Winding Relationship

In this example of a delta service, three wires will transmit the power to the load. In a true delta service, the phase-to-ground voltage will usually not be balanced because the ground is not at the center of the delta.

Figure 1.4 shows the phasor relationships between voltage and current on a three-phase delta circuit.

In many delta services, one corner of the delta is grounded. This means the phase to ground voltage will be zero for one phase and will be full phase-to-phase voltage for the other two phases. This is done for protective purposes.

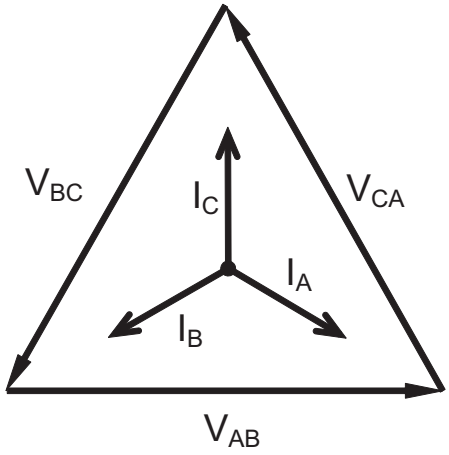


Figure 1.4: Phasor Diagram, Three-Phase Voltages and Currents, Delta-Connected

Another common delta connection is the four-wire, grounded delta used for lighting loads. In this connection the center point of one winding is grounded. On a 120/240 volt, four-wire, grounded delta service the phase-to-ground voltage would be 120 volts on two phases and 208 volts on the third phase. Figure 1.5 shows the phasor diagram for the voltages in a three-phase, four-wire delta system.

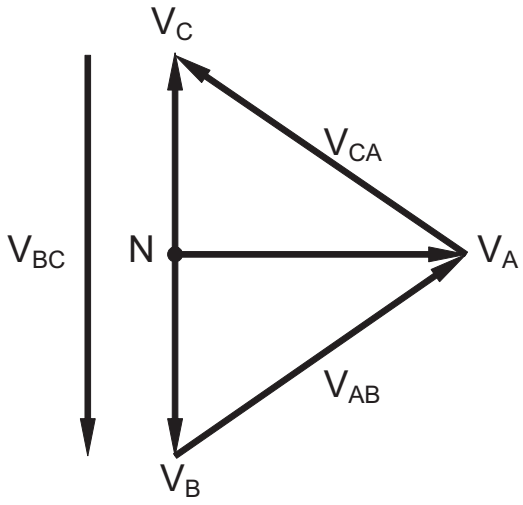


Figure 1.5: Phasor Diagram Showing Three-phase Four-Wire Delta-Connected System

1.1.3: Blondel's Theorem and Three Phase Measurement

In 1893 an engineer and mathematician named Andre E. Blondel set forth the first scientific basis for polyphase metering. His theorem states:

If energy is supplied to any system of conductors through N wires, the total power in the system is given by the algebraic sum of the readings of N wattmeters so arranged that each of the N wires contains one current coil, the corresponding potential coil being connected between that wire and some common point. If this common point is on one of the N wires, the measurement may be made by the use of N-1 Wattmeters.

The theorem may be stated more simply, in modern language:

In a system of N conductors, N-1 meter elements will measure the power or energy taken provided that all the potential coils have a common tie to the conductor in which there is no current coil.

Three-phase power measurement is accomplished by measuring the three individual phases and adding them together to obtain the total three phase value. In older analog meters, this measurement was accomplished using up to three separate elements. Each element combined the single-phase voltage and current to produce a torque on the meter disk. All three elements were arranged around the disk so that the disk was subjected to the combined torque of the three elements. As a result the disk would turn at a higher speed and register power supplied by each of the three wires.

According to Blondel's Theorem, it was possible to reduce the number of elements under certain conditions. For example, a three-phase, three-wire delta system could be correctly measured with two elements (two potential coils and two current coils) if the potential coils were connected between the three phases with one phase in common.

In a three-phase, four-wire wye system it is necessary to use three elements. Three voltage coils are connected between the three phases and the common neutral conductor. A current coil is required in each of the three phases.

In modern digital meters, Blondel's Theorem is still applied to obtain proper metering. The difference in modern meters is that the digital meter measures each phase voltage and current and calculates the single-phase power for each phase. The meter then sums the three phase powers to a single three-phase reading.

Some digital meters measure the individual phase power values one phase at a time. This means the meter samples the voltage and current on one phase and calculates a power value. Then it samples the second phase and calculates the power for the second phase. Finally, it samples the third phase and calculates that phase power. After sampling all three phases, the meter adds the three readings to create the equivalent three-phase power value. Using mathematical averaging techniques, this method can derive a quite accurate measurement of three-phase power.

More advanced meters actually sample all three phases of voltage and current simultaneously and calculate the individual phase and three-phase power values. The advantage of simultaneous sampling is the reduction of error introduced due to the difference in time when the samples were taken.

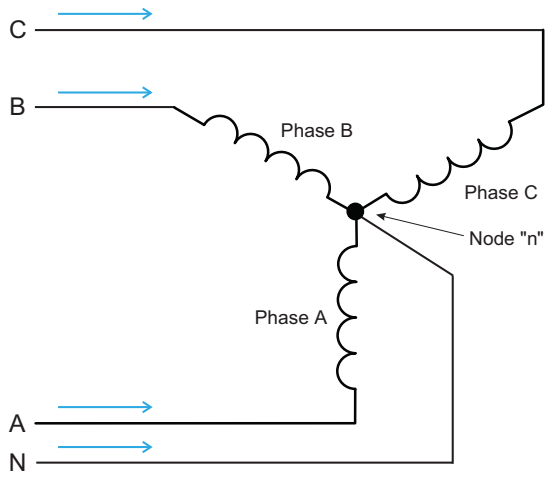


Figure 1.6: Three-Phase Wye Load Illustrating Kirchhoff's Law and Blondel's Theorem

Blondel's Theorem is a derivation that results from Kirchhoff's Law. Kirchhoff's Law states that the sum of the currents into a node is zero. Another way of stating the same thing is that the current into a node (connection point) must equal the current out of the node. The law can be applied to measuring three-phase loads. Figure 1.6 shows a typical connection of a three-phase load applied to a three-phase, four-wire service. Kirchhoff's Law holds that the sum of currents A, B, C and N must equal zero or that the sum of currents into Node "n" must equal zero.

If we measure the currents in wires A, B and C, we then know the current in wire N by Kirchhoff's Law and it is not necessary to measure it. This fact leads us to the conclusion of Blondel's Theorem- that we only need to measure the power in three of

the four wires if they are connected by a common node. In the circuit of Figure 1.6 we must measure the power flow in three wires. This will require three voltage coils and three current coils (a three-element meter). Similar figures and conclusions could be reached for other circuit configurations involving Delta-connected loads.

1.2: Power, Energy and Demand

It is quite common to exchange power, energy and demand without differentiating between the three. Because this practice can lead to confusion, the differences between these three measurements will be discussed.

Power is an instantaneous reading. The power reading provided by a meter is the present flow of watts. Power is measured immediately just like current. In many digital meters, the power value is actually measured and calculated over a one second interval because it takes some amount of time to calculate the RMS values of voltage and current. But this time interval is kept small to preserve the instantaneous nature of power.

Energy is always based on some time increment; it is the integration of power over a defined time increment. Energy is an important value because almost all electric bills are based, in part, on the amount of energy used.

Typically, electrical energy is measured in units of kilowatt-hours (kWh). A kilowatt-hour represents a constant load of one thousand watts (one kilowatt) for one hour. Stated another way, if the power delivered (instantaneous watts) is measured as 1,000 watts and the load was served for a one hour time interval then the load would have absorbed one kilowatt-hour of energy. A different load may have a constant power requirement of 4,000 watts. If the load were served for one hour it would absorb four kWh. If the load were served for 15 minutes it would absorb ¼ of that total or one kWh.

Figure 1.7 shows a graph of power and the resulting energy that would be transmitted as a result of the illustrated power values. For this illustration, it is assumed that the power level is held constant for each minute when a measurement is taken. Each bar in the graph will represent the power load for the one-minute increment of time. In real life the power value moves almost constantly.

The data from Figure 1.7 is reproduced in Table 2 to illustrate the calculation of energy. Since the time increment of the measurement is one minute and since we

specified that the load is constant over that minute, we can convert the power reading to an equivalent consumed energy reading by multiplying the power reading times 1/60 (converting the time base from minutes to hours).

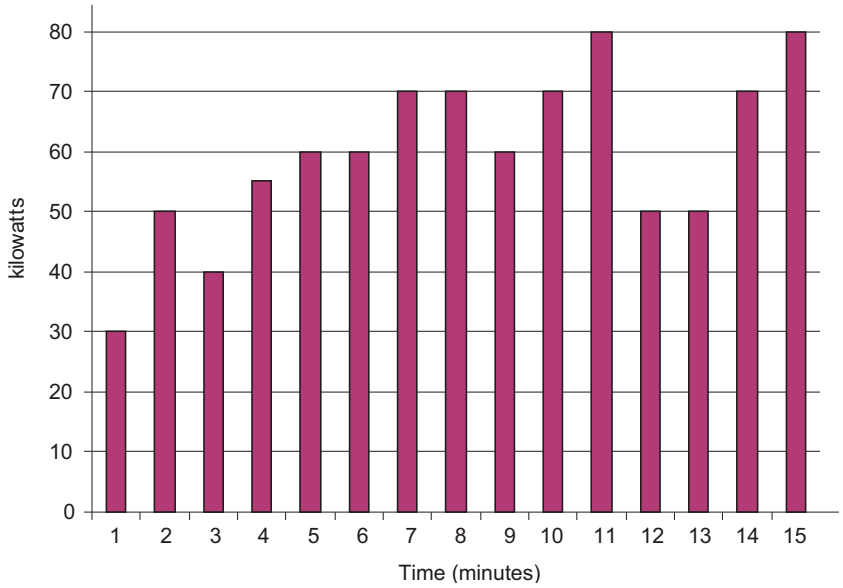


Figure 1.7: Power Use over Time

Time Interval (minute)	Power (kW)	Energy (kWh)	Accumulated Energy (kWh)
1	30	0.50	0.50
2	50	0.83	1.33
3	40	0.67	2.00
4	55	0.92	2.92
5	60	1.00	3.92
6	60	1.00	4.92
7	70	1.17	6.09
8	70	1.17	7.26
9	60	1.00	8.26
10	70	1.17	9.43
11	80	1.33	10.76
12	50	0.83	12.42
13	50	0.83	12.42
14	70	1.17	13.59
15	80	1.33	14.92

Table 1.2: Power and Energy Relationship over Time

As in Table 1.2, the accumulated energy for the power load profile of Figure 1.7 is 14.92 kWh.

Demand is also a time-based value. The demand is the average rate of energy use over time. The actual label for demand is kilowatt-hours/hour but this is normally reduced to kilowatts. This makes it easy to confuse demand with power, but demand is not an instantaneous value. To calculate demand it is necessary to accumulate the energy readings (as illustrated in Figure 1.7) and adjust the energy reading to an hourly value that constitutes the demand.

In the example, the accumulated energy is 14.92 kWh. But this measurement was made over a 15-minute interval. To convert the reading to a demand value, it must be normalized to a 60-minute interval. If the pattern were repeated for an additional three 15-minute intervals the total energy would be four times the measured value or

59.68 kWh. The same process is applied to calculate the 15-minute demand value. The demand value associated with the example load is 59.68 kWh/hr or 59.68 kWd. Note that the peak instantaneous value of power is 80 kW, significantly more than the demand value.

Figure 1.8 shows another example of energy and demand. In this case, each bar represents the energy consumed in a 15-minute interval. The energy use in each interval typically falls between 50 and 70 kWh. However, during two intervals the energy rises sharply and peaks at 100 kWh in interval number 7. This peak of usage will result in setting a high demand reading. For each interval shown the demand value would be four times the indicated energy reading. So interval 1 would have an associated demand of 240 kWh/hr. Interval 7 will have a demand value of 400 kWh/hr. In the data shown, this is the peak demand value and would be the number that would set the demand charge on the utility bill.

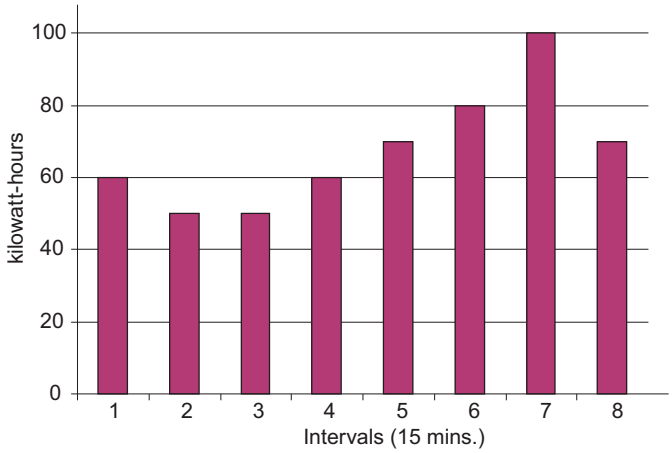


Figure 1.8: Energy Use and Demand

As can be seen from this example, it is important to recognize the relationships between power, energy and demand in order to control loads effectively or to monitor use correctly.

1.3: Reactive Energy and Power Factor

The real power and energy measurements discussed in the previous section relate to the quantities that are most used in electrical systems. But it is often not sufficient to only measure real power and energy. Reactive power is a critical component of the total power picture because almost all real-life applications have an impact on reactive power. Reactive power and power factor concepts relate to both load and generation applications. However, this discussion will be limited to analysis of reactive power and power factor as they relate to loads. To simplify the discussion, generation will not be considered.

Real power (and energy) is the component of power that is the combination of the voltage and the value of corresponding current that is directly in phase with the voltage. However, in actual practice the total current is almost never in phase with the voltage. Since the current is not in phase with the voltage, it is necessary to consider both the inphase component and the component that is at quadrature (angularly rotated 90^o or perpendicular) to the voltage. Figure 1.9 shows a single-phase voltage and current and breaks the current into its in-phase and quadrature components.

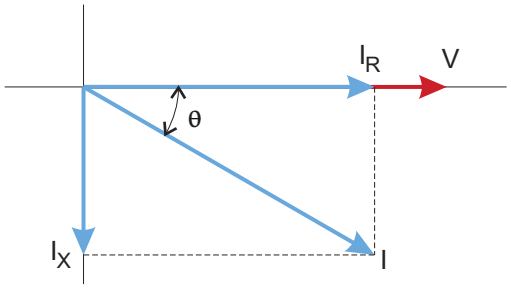


Figure 1.9: Voltage and Complex Current

The voltage (V) and the total current (I) can be combined to calculate the apparent power or VA. The voltage and the in-phase current (I_R) are combined to produce the real power or watts. The voltage and the quadrature current (I_X) are combined to calculate the reactive power.

The quadrature current may be lagging the voltage (as shown in Figure 1.9) or it may lead the voltage. When the quadrature current lags the voltage the load is requiring both real power (watts) and reactive power (VARs). When the quadrature current

leads the voltage the load is requiring real power (watts) but is delivering reactive power (VARs) back into the system; that is VARs are flowing in the opposite direction of the real power flow.

Reactive power (VARs) is required in all power systems. Any equipment that uses magnetization to operate requires VARs. Usually the magnitude of VARs is relatively low compared to the real power quantities. Utilities have an interest in maintaining VAR requirements at the customer to a low value in order to maximize the return on plant invested to deliver energy. When lines are carrying VARs, they cannot carry as many watts. So keeping the VAR content low allows a line to carry its full capacity of watts. In order to encourage customers to keep VAR requirements low, some utilities impose a penalty if the VAR content of the load rises above a specified value.

A common method of measuring reactive power requirements is power factor. Power factor can be defined in two different ways. The more common method of calculating power factor is the ratio of the real power to the apparent power. This relationship is expressed in the following formula:

Total PF = real power / apparent power = watts/VA

This formula calculates a power factor quantity known as Total Power Factor. It is called Total PF because it is based on the ratios of the power delivered. The delivered power quantities will include the impacts of any existing harmonic content. If the voltage or current includes high levels of harmonic distortion the power values will be affected. By calculating power factor from the power values, the power factor will include the impact of harmonic distortion. In many cases this is the preferred method of calculation because the entire impact of the actual voltage and current are included.

A second type of power factor is Displacement Power Factor. Displacement PF is based on the angular relationship between the voltage and current. Displacement power factor does not consider the magnitudes of voltage, current or power. It is solely based on the phase angle differences. As a result, it does not include the impact of

harmonic distortion. Displacement power factor is calculated using the following equation:

$$\text{Displacement PF} = \cos\theta$$

where θ is the angle between the voltage and the current (see Fig. 1.9).

In applications where the voltage and current are not distorted, the Total Power Factor will equal the Displacement Power Factor. But if harmonic distortion is present, the two power factors will not be equal.

1.4: Harmonic Distortion

Harmonic distortion is primarily the result of high concentrations of non-linear loads. Devices such as computer power supplies, variable speed drives and fluorescent light ballasts make current demands that do not match the sinusoidal waveform of AC electricity. As a result, the current waveform feeding these loads is periodic but not sinusoidal. Figure 1.10 shows a normal, sinusoidal current waveform. This example has no distortion.

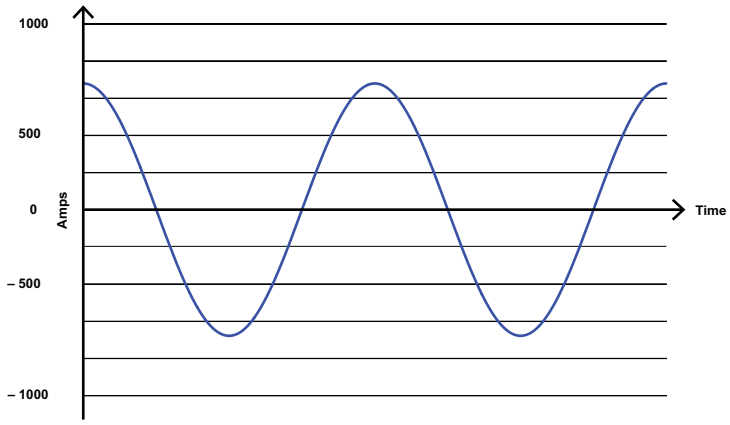


Figure 1.10: Nondistorted Current Waveform

Figure 1.11 shows a current waveform with a slight amount of harmonic distortion. The waveform is still periodic and is fluctuating at the normal 60 Hz frequency. However, the waveform is not a smooth sinusoidal form as seen in Figure 1.10.

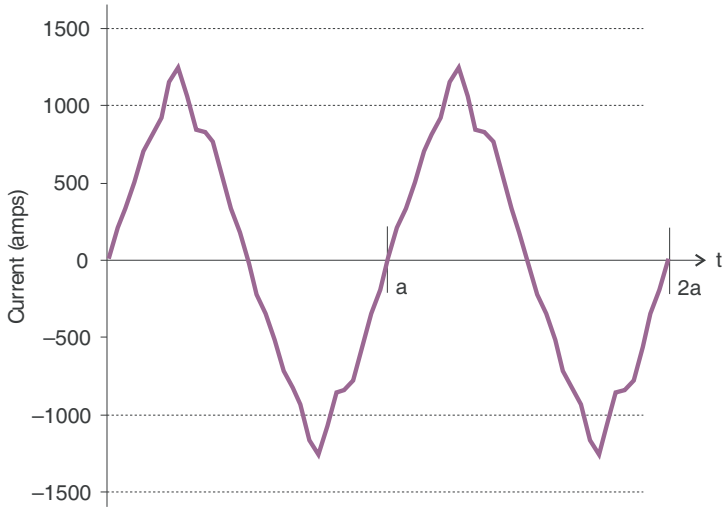


Figure 1.11: Distorted Current Waveform

The distortion observed in Figure 1.11 can be modeled as the sum of several sinusoidal waveforms of frequencies that are multiples of the fundamental 60 Hz frequency. This modeling is performed by mathematically disassembling the distorted waveform into a collection of higher frequency waveforms.

These higher frequency waveforms are referred to as harmonics. Figure 1.12 shows the content of the harmonic frequencies that make up the distortion portion of the waveform in Figure 1.11.

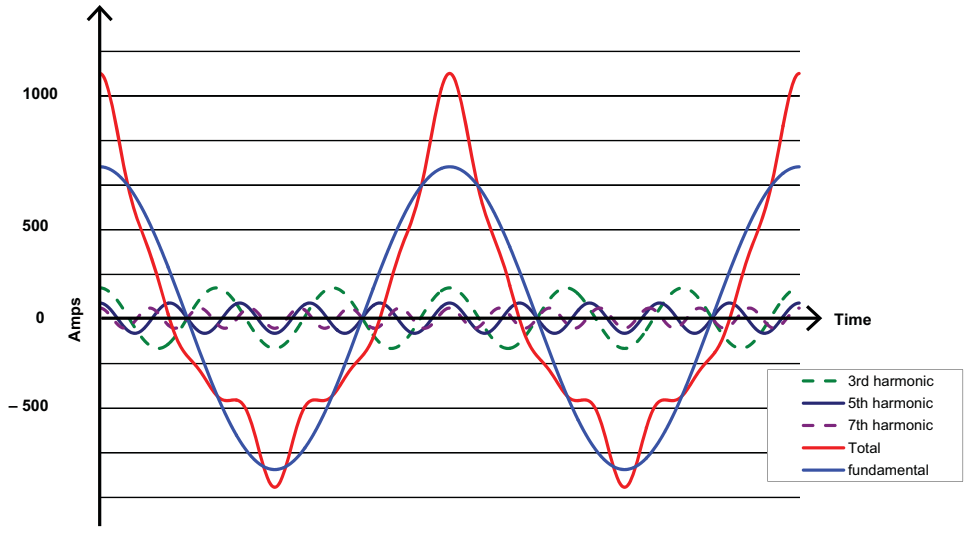


Figure 1.12: Waveforms of the Harmonics

The waveforms shown in Figure 1.12 are not smoothed but do provide an indication of the impact of combining multiple harmonic frequencies together.

When harmonics are present it is important to remember that these quantities are operating at higher frequencies. Therefore, they do not always respond in the same manner as 60 Hz values.

Inductive and capacitive impedance are present in all power systems. We are accustomed to thinking about these impedances as they perform at 60 Hz. However, these impedances are subject to frequency variation.

$X_L = j\omega L$ and

$X_C = 1/j\omega C$

At 60 Hz, $\omega = 377$; but at 300 Hz (5th harmonic) $\omega = 1{,}885$. As frequency changes impedance changes and system impedance characteristics that are normal at 60 Hz may behave entirely differently in the presence of higher order harmonic waveforms.

Traditionally, the most common harmonics have been the low order, odd frequencies, such as the 3rd, 5th, 7th, and 9th. However newer, non-linear loads are introducing significant quantities of higher order harmonics.

Since much voltage monitoring and almost all current monitoring is performed using instrument transformers, the higher order harmonics are often not visible. Instrument transformers are designed to pass 60 Hz quantities with high accuracy. These devices, when designed for accuracy at low frequency, do not pass high frequencies with high accuracy; at frequencies above about 1200 Hz they pass almost no information. So when instrument transformers are used, they effectively filter out higher frequency harmonic distortion making it impossible to see.

However, when monitors can be connected directly to the measured circuit (such as direct connection to a 480 volt bus) the user may often see higher order harmonic distortion. An important rule in any harmonics study is to evaluate the type of equipment and connections before drawing a conclusion. Not being able to see harmonic distortion is not the same as not having harmonic distortion.

It is common in advanced meters to perform a function commonly referred to as waveform capture. Waveform capture is the ability of a meter to capture a present picture of the voltage or current waveform for viewing and harmonic analysis.

Typically a waveform capture will be one or two cycles in duration and can be viewed as the actual waveform, as a spectral view of the harmonic content, or a tabular view showing the magnitude and phase shift of each harmonic value. Data collected with waveform capture is typically not saved to memory. Waveform capture is a real-time data collection event.

Waveform capture should not be confused with waveform recording that is used to record multiple cycles of all voltage and current waveforms in response to a transient condition.

1.5: Power Quality

Power quality can mean several different things. The terms "power quality" and "power quality problem" have been applied to all types of conditions. A simple definition of "power quality problem" is any voltage, current or frequency deviation that results in mis-operation or failure of customer equipment or systems. The causes of power quality problems vary widely and may originate in the customer equipment, in an adjacent customer facility or with the utility.

In his book Power Quality Primer, Barry Kennedy provided information on different types of power quality problems. Some of that information is summarized in Table 1.3.

Cause	Disturbance Type	Source
Impulse transient	Transient voltage disturbance, sub-cycle duration	Lightning Electrostatic discharge Load switching Capacitor switching
Oscillatory transient with decay	Transient voltage, sub-cycle duration	Line/cable switching Capacitor switching Load switching
Sag/swell	RMS voltage, multiple cycle duration	Remote system faults
Interruptions	RMS voltage, multiple seconds or longer duration	System protection Circuit breakers Fuses Maintenance
Under voltage/over voltage	RMS voltage, steady state, multiple seconds or longer duration	Motor starting Load variations Load dropping
Voltage flicker	RMS voltage, steady state, repetitive condition	Intermittent loads Motor starting Arc furnaces
Harmonic distortion	Steady state current or voltage, long-term duration	Non-linear loads System resonance

Table 1.3: Typical Power Quality Problems and Sources

It is often assumed that power quality problems originate with the utility. While it is true that many power quality problems can originate with the utility system, many problems originate with customer equipment. Customer-caused problems may manifest themselves inside the customer location or they may be transported by the utility system to another adjacent customer. Often, equipment that is sensitive to power quality problems may in fact also be the cause of the problem.

If a power quality problem is suspected, it is generally wise to consult a power quality professional for assistance in defining the cause and possible solutions to the problem.

2: Meter Overview and Specifications

2.1: Hardware Overview

The Shark® 100 monitor is a multifunction power meter designed to be used in electrical substations, panel boards and as a power meter for OEM equipment. The unit provides multifunction measurement of all electrical parameters.

Figure 2.1: Shark® 100 Meter

The unit is designed with advanced measurement capabilities, allowing it to achieve high performance accuracy. The Shark 100® meter is specified as a 0.2% class energy meter for billing applications as well as a highly accurate panel indication meter. The Shark® 50 meter is specified as a 0.5% class energy meter.

The Shark® 100 meter provides a host of additional capabilities, including either standard RS485 Modbus® or RJ45 Ethernet, DNP Protocols and an IrDA Port panel mount interrogation. The Shark® 50 meter has optional RS485 Modbus communication.

Shark® 100 meter features that are detailed in this manual are as follows:

- 0.2% class revenue certifiable energy and demand metering
- Meets ANSI C12.20 (0.2%) and IEC 62053-22 (0.2%) accuracy classes
- Multifunction measurement including voltage, current, power, frequency, energy, etc.
- Power quality measurements (%THD and Alarm Limits)
- V-Switch™ key technology - field upgrade without removing installed meter
- Percentage of Load bar for analog meter perception
- Easy to use faceplate programming

- IrDA port for laptop PC reading and programming
- RS485 or RJ45 Modbus communication

The Shark® 100 comes in either of two models - the Meter/Transducer or the Transducer only.

Shark® 100 Meter / Digital Transducer

Meter and transducer in one compact unit. Features an IrDA port as well as either an RS485 or RJ45 port, and can be programmed using the faceplate of the meter. ANSI or DIN mounting may be used (see Figure 2.1).

Shark® 100T Digital Transducer

A Digital Transducer only unit providing either RS485 or RJ45 communication via Modbus RTU, Modbus ASCII and DNP 3.0 (V3 and V4) protocols. The unit is designed to install using DIN Rail Mounting (see Section 3.4).

Figure 2.2: Digital Transducer Only Model

Shark® 100B Meter / Digital Transducer

The Building Automation and Control Network (BACnet®), described in the ANSI/ASHRAE Standard 135-1995, is one of the most widely used building management systems protocols. The Shark® 100B meter has embedded BACnet/IP communication. It communicates in native BACnet/IP over Ethernet to seamlessly integrate with most building automation/control systems. The Shark® 100B meter's BACnet/IP has 40 predefined BACnet objects that let you track up to 40 measurements. No programming or mapping is necessary to use the BACnet objects. (The Shark® 50B also supports BACnet communication - see the next page for a description.)

The Shark® 100B meter also comes with a Web interface that is very easy to set up and use. This lets you remotely configure BACnet/IP and track energy usage through the Internet using a standard browser. You can also access all of the Shark® 100B meter's readings through Communicator EXT™ software. See chapters 6 and 7 for more information on the BACnet/IP webpages and Communicator EXT™ 4.0 software. **NOTE: The Shark® 100B meter comes standard with RJ45 Ethernet. It does not have the RS485 Option.** See Chapter 7 for detailed instructions on using the Shark® 100B meter.

Shark® 50 meter

The Shark® 50 meter is similar in functionality to the Shark® 100 meter, except that it is a 0.5% class energy meter with basic features. It is intended as an option when the Shark® 100 meter's advanced features are not needed. For communication, it has an RS485/Pulse Outputs option (Option 485P). Since it doesn't have an IrDA port, Limits, or %THD readings, its face-plate is slightly different from the images shown of the Shark® 100 meter's faceplate.

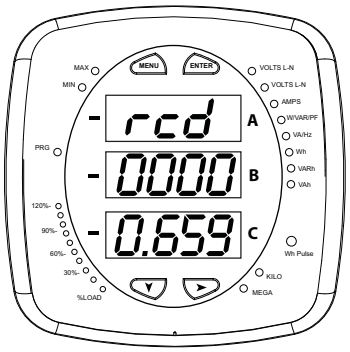


Figure 2.3: Shark® 50 Meter Faceplate

Shark® 50B meter

The Shark® 50B meter also offers BACnet protocol communication. While the Shark®100B supports BACnet/IP, which is the fastest communication mode for BACnet, the Shark® 50B meter uses BACnet MS/TP (master-slave/token-passing), which was designed by ASHRAE for devices with lower requirements in terms of speed. BACnet MS/TP is designed to run at speeds of 1 Mbps or less over twisted pair wiring.

The Shark® 50B meter has dual communication ports, so in addition to the RS485 port speaking BACnet MS/TP, it has an RJ45 Ethernet port speaking Modbus TCP/IP. The Ethernet port supports a Web interface that is very easy to set up and use. This lets you remotely configure the BACnet MS/TP settings and track energy usage through the Internet using a standard browser. You can also access all of the Shark® 50B meter's readings through Communicator EXT™ 4.0 software. See Chapter 6 for

more information on the Communicator EXT™ 4.0 software and Chapter 8 for detailed instructions on using the Shark® 50B meter.

2.1.1: Voltage and Current Inputs

Universal Voltage Inputs

Voltage inputs allow measurement to 416 volts Line-to-Neutral and 721 volts Line-to-Line. This insures proper meter safety when wiring directly to high voltage systems. One unit will perform to specification on 69 Volt, 120 Volt, 230 Volt, 277 Volt, 277 Volt and 347 Volt power systems.

Current Inputs

The Shark® 100/50 meter's current inputs use a unique dual input method:

Method 1: CT Pass Through

The CT wire passes directly through the meter without any physical termination on the meter. This insures that the meter cannot be a point of failure on the CT circuit. This is preferable for utility users when sharing relay class CTs. No Burden is added to the secondary CT circuit.

Method 2: Current "Gills"

This unit additionally provides ultra-rugged termination pass through bars that allow CT leads to be terminated on the meter. This, too, eliminates any possible point of failure at the meter. This is a preferred technique for insuring that relay class CT integrity is not compromised (the CT will not open in a fault condition).

2.1.2: Model Number plus Option Numbers

Shark® 100/100T Ordering chart

Model	Freq.	Current Class	V-Switch™ Pack	Power Supply	COM (Meter Only)	Mounting (Meter Only)
Shark® 100 Meter/ Transducer	50 50 Hz System	10 5 Amp Secondary	V1 Default V-Switch™ Volts/ Amps	D2 90-265 VAC/ 100-370 VDC	X No Com	X ANSI Mounting
Shark® 100T Transducer Only	60 60 Hz System	2 1 Amp Secondary	V2 above with Power and Freq	D 18-60 VDC	485P RS485 + Pulse (Standard in Transducer Only)	DIN DIN Mounting
			V3 above with DNP 3.0 and Energy Counters		INP10 10/100 BaseT Ethernet	
			V4 above with Harmonics and Limits			

Shark® 100B/100BT Ordering chart

Model	Frequency	Current Class	Power Supply	Mounting
Shark® 100B Meter/ Transducer	50 50 Hz System	10 5 Amp Secondary	D2 90-265 VAC or 100-370 VDC	X ANSI Mounting
Shark® 100BT Transducer Only	60 60 Hz System	2 1 Amp Secondary	D 18-60 VDC	DIN DIN Mounting

NOTE: INP10 (10/100BaseT Ethernet) is standard in the Shark® 100B/100BT meter.

Shark® 50 Ordering Chart

Model	V-Switch™ Pack	COM	Mounting
Shark® 50 Meter/ Transducer	V1 Default V-Switch™ Volts/Amps	X No Com	X ANSI Mounting
	V2 Above, with Power & Frequency	485P RS485 + Pulse	DIN DIN Mounting
	V3 Above with Energy Counters		

Shark® 50B Ordering Chart

Model	Mounting
Shark® 50B Meter/ Transducer	X ANSI Mounting
	DIN DIN Mounting

NOTE: INP10 (10/100BaseT Ethernet) is standard in the Shark® 50B meter.

Example:

Shark 100 - 60 -10 -V2 -D -X -ANSI

which translates to a Shark® 100 meter/transducer, with 60Hz system, Class 10, V2 V-Switch™ key, 24-48 VDC power supply, no optional Com, and ANSI Mounting.

2.1.3: V-Switch™ Key Technology

EIG's exclusive V-Switch™ key technology is a virtual firmware-based switch that lets you enable meter features through communication. This allows the Shark® 100/50 unit to be upgraded after installation to a higher model without removing the unit from service.

NOTE: See the Shark® 50 meter's Ordering chart on the previous page for its V-Switch™ keys.

Available V-Switch™ Keys

V-Switch™ Key 1 (V1): volts and amps Meter - Default

V-Switch™ Key 2 (V2): volts, amps, kW, kVAR, PF, kVA, Freq

V-Switch™ Key 3 (V3): volts, amps, kW, kVAR, PF, kVA, Freq., kWh, kVAh, kVARh & DNP 3.0

V-Switch™ Key 4 (V4): volts, amps, kW, kVAR, PF, kVA, Freq., kWh, kVAh, kVARh, %THD Monitoring, Limit Exceeded Alarms and DNP 3.0

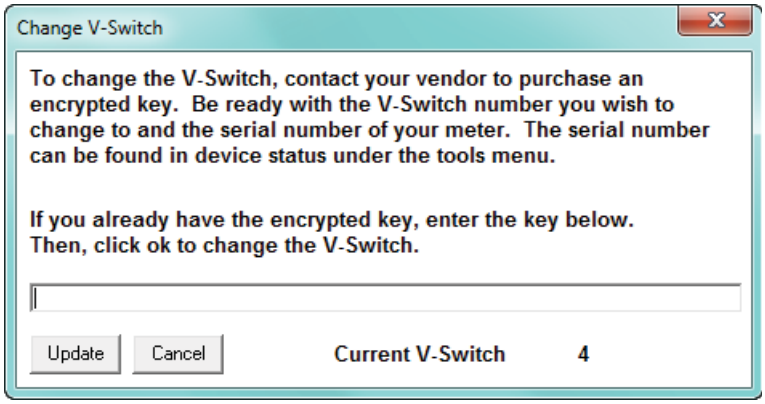
Obtaining a V-Switch™ Key:

Contact EIG's inside sales staff at sales@electroind.com or by calling (516) 334-0870 (USA) and provide the following information:

1. Serial Number or Numbers of the meters you are upgrading. Use the number(s), with leading zeros, shown in the Communicator EXT™ Device Status screen (from the Communicator EXT™ Main screen, click **Tools>Device Status**).
2. Desired V-Switch™ key.
3. Credit Card or Purchase Order Number. EIG will issue you the V-Switch™ key.

Enabling the V-Switch™ Key:

1. Open the Communicator EXT™ application.
2. Power up your meter.
3. Connect to the Shark® 100/50 meter through the Communicator EXT™ application (see Chapter 6).
4. Click the **Profile** icon.
5. Click the Settings tab.
6. Click the **Change** button next to Change VSwitch™. A screen opens, requesting the encrypted key. Enter the V-Switch™ key provided by EIG.


Change V-Switch
To change the V-Switch, contact your vendor to purchase an encrypted key. Be ready with the V-Switch number you wish to change to and the serial number of your meter. The serial number can be found in device status under the tools menu.
If you already have the encrypted key, enter the key below. Then, click ok to change the V-Switch.
Update
Cancel
Current V-Switch
4

7. Click the **Update** button. The V-Switch™ key is enabled and the meter is reset.

NOTES:

- For more details on software configuration, refer to the *Communicator EXT™ 4.0 and MeterManager EXT Software User Manual*.
- The Shark® 50B and 100B meters do not have any V-Switch™ key options.

2.1.4: Measured Values

The following table lists the measured values available in Real Time, Average, Maximum, and Minimum.

Meter's Measured Values				
Measured Values	**Real Time**	**Average**	**Max**	**Min**
Voltage L-N	X		X	X
Voltage L-L	X		X	X
Current per Phase	X	X	X	X
Current Neutral	X			
Watts	X	X	X	X
VAR	X	X	X	X
VA	X	X	X	X
PF	X	X	X	X
+Watt-hr	X			
-Watt-hr	X			
Watt-hr Net	X			
+VAR-hr	X			
-VAR-hr	X			
VAR-hr Net	X			
VA-hr	X			
Frequency	X		X	X
**%THD	X		X	X
Voltage Angles	X			
Current Angles	X			
% of Load Bar	X			

** The Shark® 100 meter measures harmonics up to the 7th order for current and up to the 3rd order for voltage. The Shark® 50/50B meter does not provide %THD.

2.1.5: Utility Peak Demand

The Shark® 100/50 meter provides user-configured Block (Fixed) Window or Rolling Window Demand. This feature lets you set up a customized Demand profile. Block Window Demand is demand over a user-configured demand period (usually 5, 15 or 30 minutes). Rolling Window Demand is a fixed window demand that moves for a user-specified subinterval period. For example, a 15-minute demand using 3 subintervals and providing a new Demand reading every 5 minutes, based on the last 15 minutes.

Utility Demand features can be used to calculate kW, kVAR, kVA and PF readings. All other parameters offer Max and Min capability over the user-selectable averaging period. Voltage provides an instantaneous Max and Min reading which displays the highest surge and lowest sag seen by the meter.

2.2: Specifications

Power Supply

Range:	D2 option: Universal, (90 to 265) VAC @50/60Hz or (100 to 370)VDC D option: (18-60) VDC (The Shark® 50/50B meter has the D2 power supply, only)
Power Consumption:	5 VA, 3.5 W

Voltage Inputs (Measurement Category III)

Range:	Universal, auto-ranging up to 416 VAC L-N, 721 VAC L-L
Supported Hookups:	3 Element Wye, 2.5 Element Wye, 2 Element Delta, 4 Wire Delta
Input Impedance:	1M ohm/phase
Burden:	0.0144 VA/phase at 120 volts
Pickup Voltage:	10Vac
Connection:	Screw terminal (Diagram 4.4)

Max Input Wire Gauge:	AWG#12 / 2.5mm^2
Fault Withstand:	Meets IEEE C37.90.1
Reading:	Programmable full scale to any PT ratio

Current Inputs

Class 10:	5 A nominal, 10 A maximum
Class 2:	1 A nominal, 2 A maximum (Shark®50/50B is Class 10 only)
Burden:	0.005 VA per phase max at 11 A
Pickup Current:	0.1% of nominal
Connections:	O or U lug electrical connection (Figure 4.1)
	Pass through wire, 0.177" / 4.5mm maximum diameter (Figure 4.2)
	Quick connect, 0.25" male tab (Figure 4.3)
Fault Withstand (at 23° C):	100 A/10 seconds, 300 A/3 seconds, 500 A/1 second
Reading:	Programmable full scale to any CT ratio

Isolation

All Inputs and Outputs are galvanically isolated to 2500 VAC

Environmental Rating

Storage:	(-20 to +70) °C
Operating:	(-20 to +70) °C

Humidity:	To 95% RH non-condensing
Faceplate Rating:	NEMA12 (water resistant), mounting gasket included

Measurement Methods

Voltage, Current:	True RMS
Power:	Sampling at 400+ samples per cycle on all channels measured readings simultaneously
A/D Conversion:	6 simultaneous 24 bit analog to digital converters

Update Rate

Watts, VAR and VA:	Every 6 cycles
All other parameters:	Every 60 cycles (The Shark® 50 meter's update rate is every 60 cycles for all parameters)

Communication Format

1. Shark® 100 meter: RS485 (485P) or RJ45 (INP10) port through backplate*
   Shark® 100B meter: RJ45 (INP10) port through backplate is standard*
   Shark® 50 meter: RS485 (485P) port through backplate is optional*
   Shark® 50B meter: RS485 port and RJ45 port through backplate are standard**
   *KYZ pulse comes with both the RS485P and INP10 communication ports.
   **The Shark® 50B meter does not have KYZ pulse.

2. IrDA Port through faceplate (Shark® 50/50B meter does not have the IrDA port)

Protocols:	Modbus RTU, Modbus ASCII, DNP 3.0 (V3 and V4 for Shark® 100), Modbus TCP/IP, BACnet/IP (Shark® 100B meter), Modbus TCP/IP, BACnet MS/TP (Shark® 50B meter)

Com Port Baud Rate:	9,600 to 57,600 b/s
Com Port Address:	001-247
Data Format:	8 bit, no parity
Shark® 100T Transducer	Default initial communication baud 9600 (see Chapter 6)

Mechanical Parameters

Dimensions:	(Height 4.85 x width 4.85 x depth 4.25) inches, (H 12.32 x W 12.32 x D 10.54) cm
Mounting:	Mounts in 92mm square DIN or ANSI C39.1, 4" round cut-out
Weight:	2 pounds, 0.907kg (ships in a 6"/ 152.4mm cube container)

RS485/KYZ Port Specifications (485P Option)

RS485

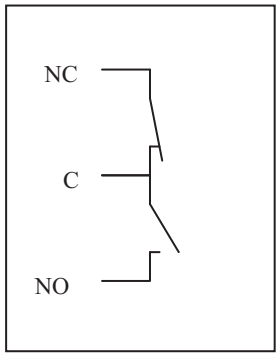
RS485 Transceiver	Meets or exceeds EIA/TIA-485 standard
Type:	Two-wire, half duplex
Min. Input Impedance:	96k Ω
Max. Output Current:	±60m A

Wh Pulse

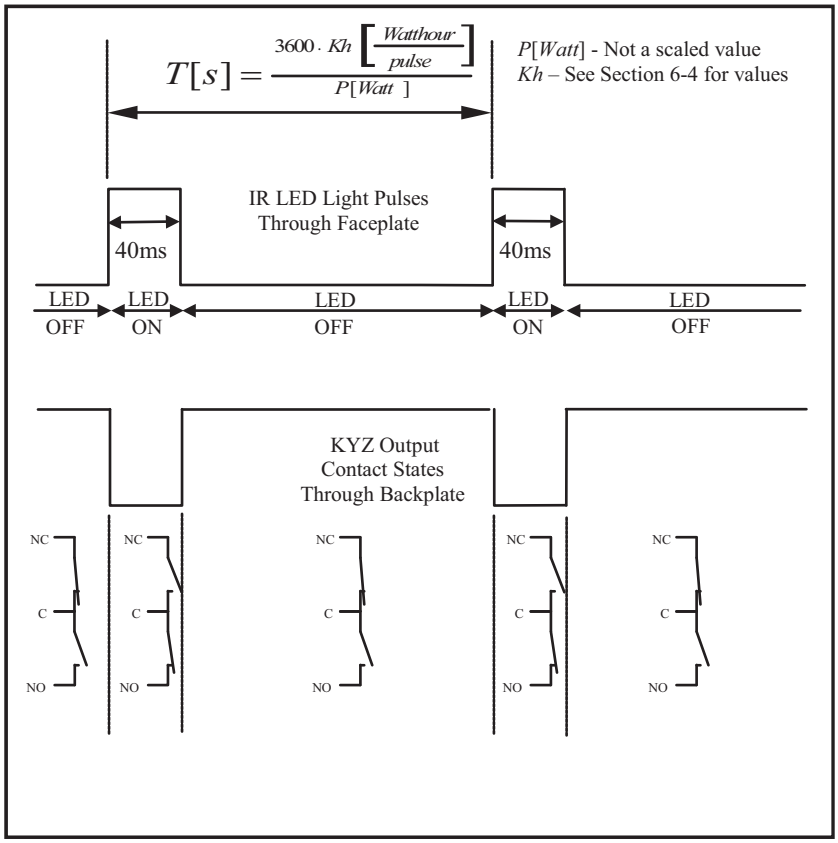
KYZ output contacts (and infrared LED light pulses through faceplate)	(See Section 6.4 for Kh values.)
Pulse Width:	40 ms
Full Scale Frequency:	~6 Hz
Contact type:	Solid state – SPDT (NO – C – NC)

Relay type:	Solid state
Peak switching voltage:	DC ±350 V
Continuous load current:	120 mA
Peak load current:	350m A for 10 ms
On resistance, max.:	35 Ω
Leakage current:	1µ A@350 V
Isolation:	AC 3750 V
Reset State:	(NC - C) Closed; (NO - C) Open
Infrared LED:	
Peak Spectral Wavelength:	940 nm
Reset State:	Off

InternalSchematic:



Output timing:



2.3: Compliance

- IEC 62053-22 (0.2% Accuracy)*
- ANSI C12.20 (0.2% Accuracy)*
- ANSI (IEEE) C37.90.1 Surge Withstand
- ANSI C62.41 (Burst)
- EN61000-6-2 Immunity for Industrial Environments: 2005
- EN61000-6-4 Emission Standards for Industrial Environments: 2007
- EN61326-1 EMC Requirements: 2006
- Certified to UL 61010-1 and CSA C22.2 No. 61010-1, UL File: E250818
- CE Compliant

* 0.5% for the Shark® 50 meter

2.4: Accuracy

For 23° C, 3 Phase balanced Wye or Delta load, at 50 or 60 Hz (as per order), 5A (Class 10) nominal unit (see next page for Shark® 50 accuracy chart):

Parameter	Accuracy	Accuracy Input Range
Voltage L-N [V]	0.1% of reading[2]	(69 to 480)V
Voltage L-L [V]	0.1% of reading	(120 to 600)V
Current Phase [A]	0.1% of reading[1]	(0.15 to 5)A
Current Neutral (calculated) [A]	2.0% of Full Scale[1]	(0.15 to 5)A @ (45 to 65)Hz
Active Power Total [W]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Active Energy Total [Wh]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Reactive Power Total [VAR]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0 to 0.8) lag/lead PF
Reactive Energy Total [VARh]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0 to 0.8) lag/lead PF
Apparent Power Total [VA]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Apparent Energy Total [VAh]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Power Factor	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Frequency	+/- 0.01Hz	(45 to 65)Hz
Total Harmonic Distortion (%)	5.0%[1]	(0.5 to 10)A or (69 to 480)V, measurement range (1 to 99.99)%
Load Bar	+/- 1 segment[1]	(0.005 to 6)A

[1] For 2.5 element programmed units, degrade accuracy by an additional 0.5% of reading.

- For 1 A (Class 2) Nominal, degrade accuracy by an additional 0.5% of reading.
- For 1 A (Class 2) Nominal, the input current range for Accuracy specification is 20% of the values listed in the table.

[2] For unbalanced voltage inputs where at least one crosses the 150 V auto-scale threshold (for example, 120 V/120 V/208 V system), degrade accuracy by additional 0.4%.

Shark® 50 Accuracy - For 23º C, 3 Phase balanced Wye or Delta load:

Parameter	Accuracy	Accuracy Input Range
Voltage L-N [V]	0.2% of reading[2]	(69 to 480)V
Voltage L-L [V]	0.4% of reading	(120 to 600)V
Current Phase [A]	0.2% of reading[1]	(0.15 to 5)A
Current Neutral (calculated) [A]	2.0% of Full Scale[1]	(0.15 to 5)A @ (45 to 65)Hz
Active Power Total [W]	0.5% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Active Energy Total [Wh]	0.5% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Reactive Power Total [VAR]	1.0% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0 to 0.8) lag/lead PF
Reactive Energy Total [VARh]	1.0% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0 to 0.8) lag/lead PF
Apparent Power Total [VA]	1.0% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Apparent Energy Total [VAh]	1.0% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Power Factor	1.0% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Frequency	+/- 0.01Hz	(45 to 65)Hz
Total Harmonic Distortion (%)	5.0%[1]	(0.5 to 10)A or (69 to 480)V, measurement range (1 to 99.99)%
Load Bar	+/- 1 segment[1]	(0.005 to 6)A

[1] For 2.5 element programmed units, degrade accuracy by an additional 0.5% of reading.

[2] For unbalanced voltage inputs where at least one crosses the 150 V auto-scale threshold (for example, 120 V/120 V/208 V system), degrade accuracy by additional 0.4%.

The Shark® 50 meter's accuracy meets the IEC62053-22 Accuracy Standards for 0.5% Class meters.

3: Mechanical Installation

3.1: Introduction

The Shark® 100/50 meter can be installed using a standard ANSI C39.1 (4" Round) or an IEC 92mm DIN (Square) form. In new installations, simply use existing DIN or ANSI punches. For existing panels, pull out old analog meters and replace with the Shark® meter. See Section 3.4 for Shark® 100T Installation. See Chapter 4 for wiring diagrams.

Recommended Tools for Shark® 100/50 Meter Installation

#2 Phillips screwdriver, small wrench and wire cutters. Shark® 100T Installation requires no tools.

Mount the meter in a dry location, which is free from dirt and corrosive substances. The meter is designed to withstand harsh environmental conditions (see Environmental Specifications in Chapter 2).

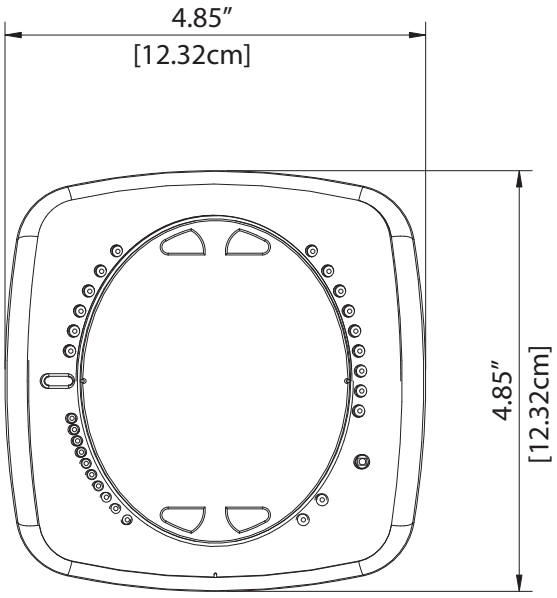


Figure 3.1: Meter Face

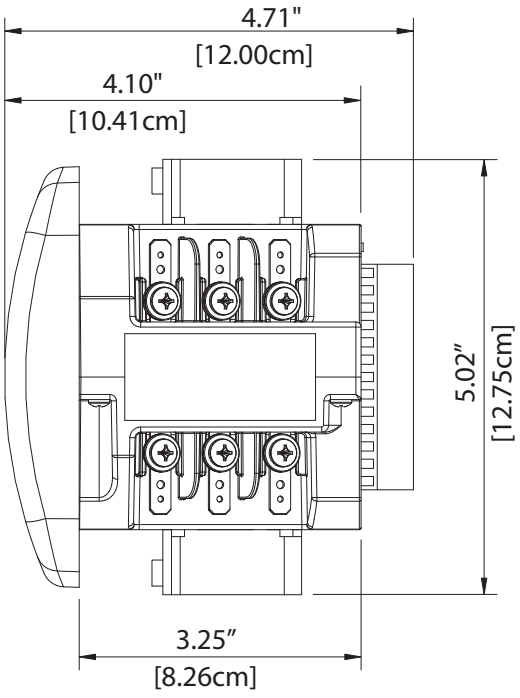


Figure 3.2: Meter Side

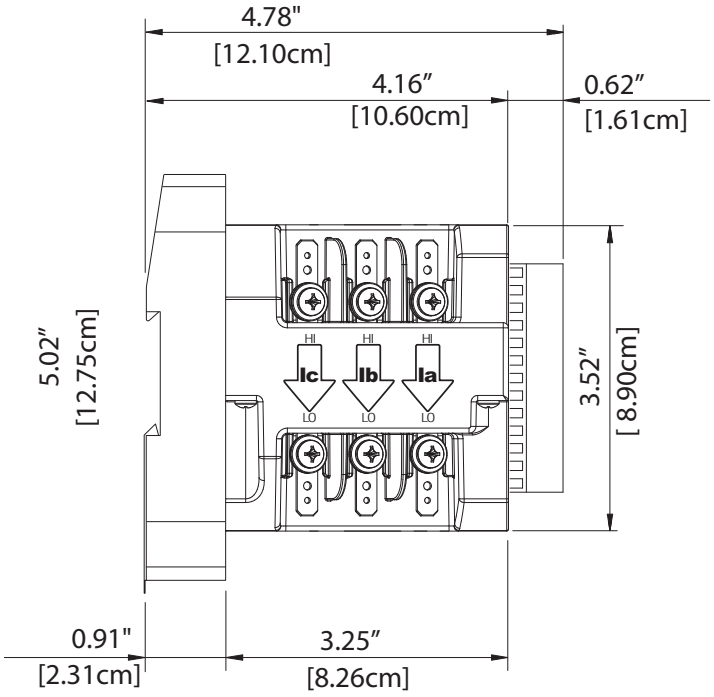


Figure 3.3: Transducer Side

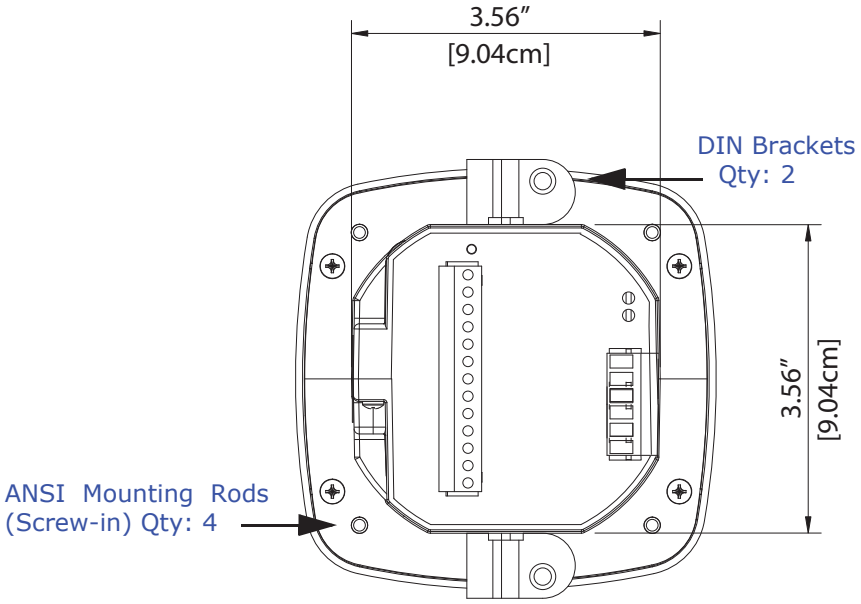


Figure 3.4: Meter Back

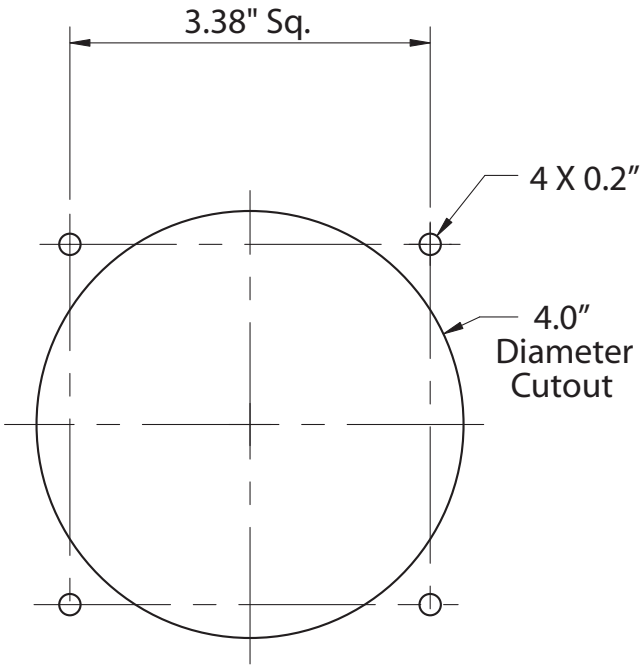


Figure 3.5: ANSI Mounting Cutout

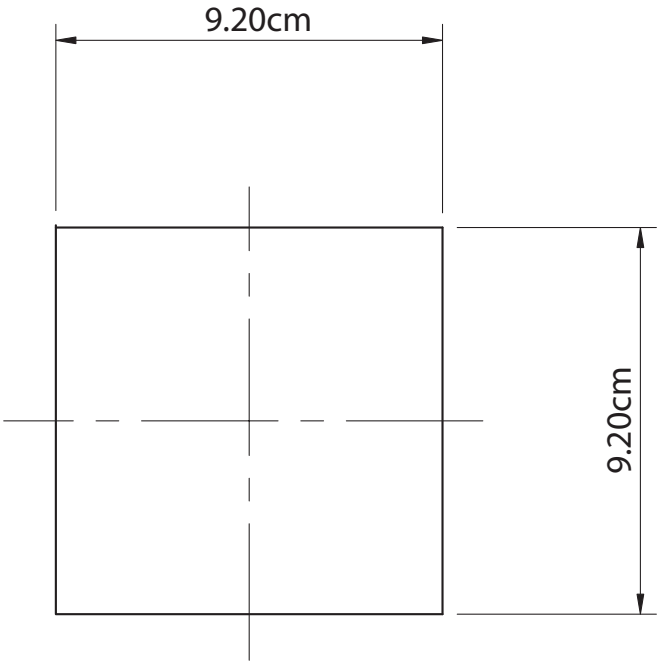
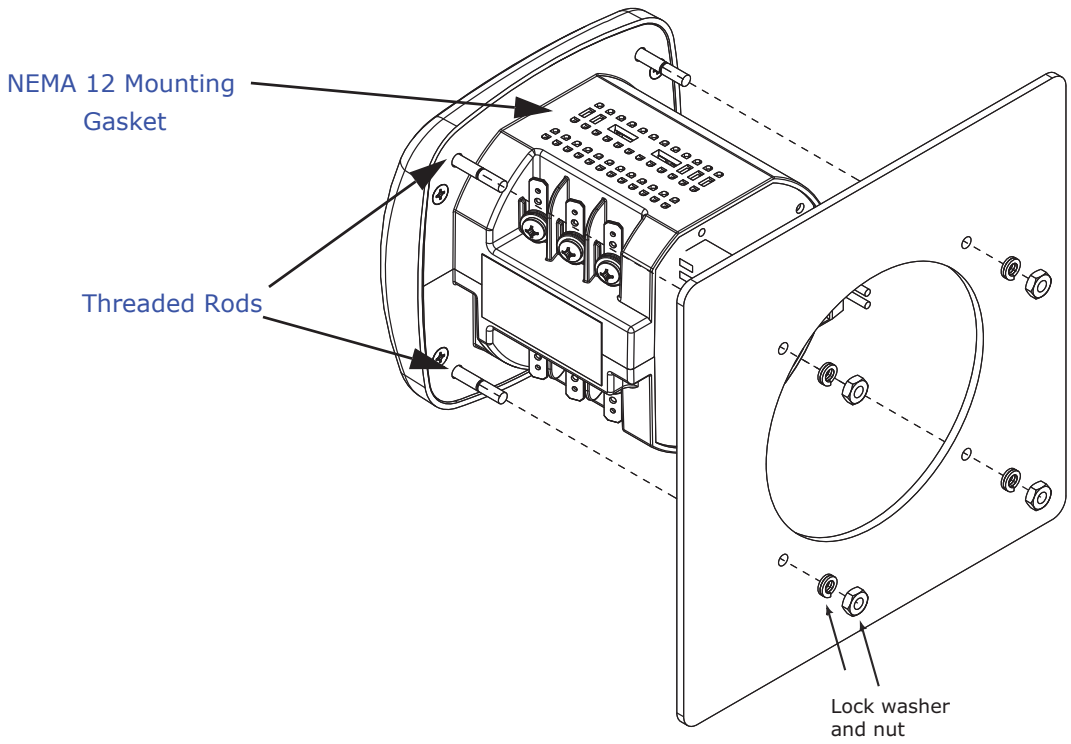
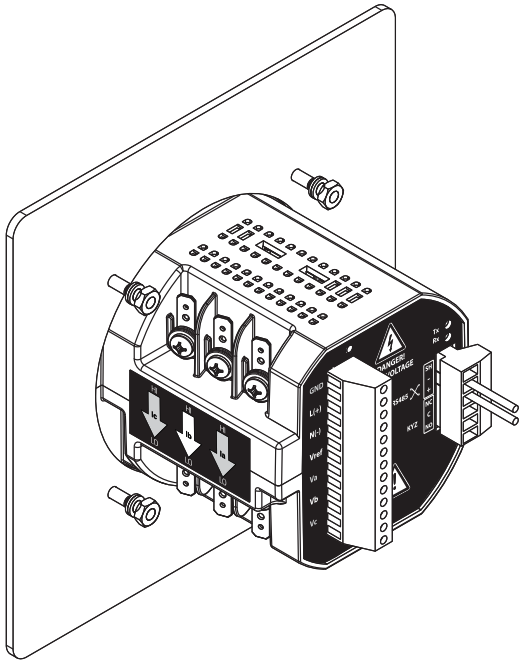


Figure 3.6: DIN Mounting Cutout

3.2: ANSI Installation Steps





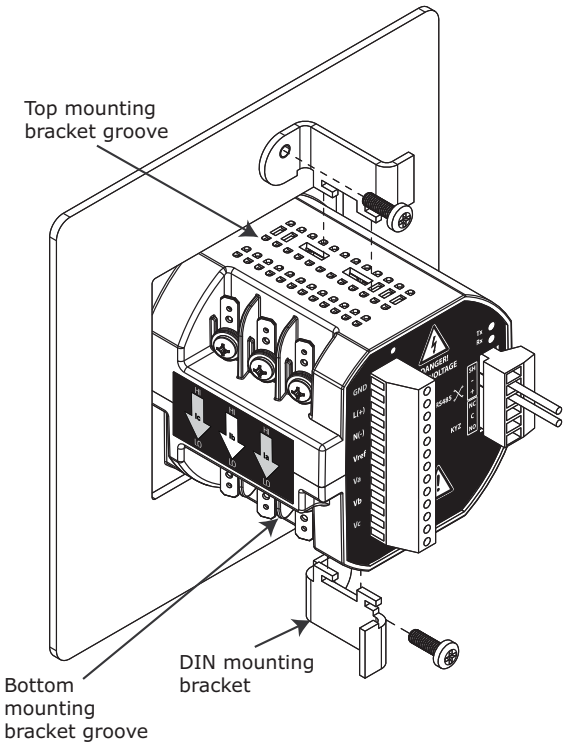
INSTALLATION STEPS:

1. Slide meter with Mounting Gasket into panel.

2. Secure from back of panel with flat washer, lock washer and nut on each threaded rod. Use a small wrench to tighten. Do not overtighten: the maximum installation torque is 0.4 Newton-Meter.

Figure 3.7: ANSI Installation

3.3: DIN Installation Steps



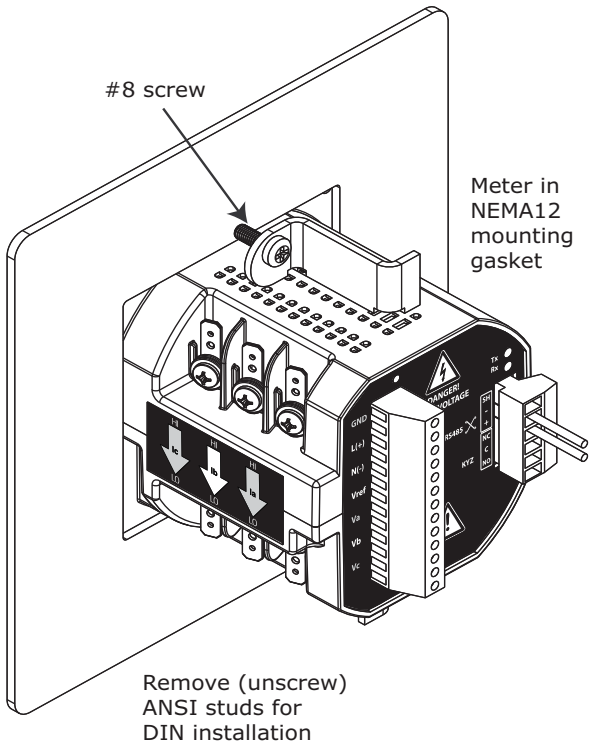


Figure 3.8: DIN Installation

INSTALLATION STEPS:

1. Slide meter with NEMA 12 Mounting Gasket into panel. (Remove ANSI Studs, if in place.)

2. From back of panel, slide 2 DIN Mounting Brackets into grooves in top and bottom of meter housing. Snap into place.

3. Secure meter to panel by using a #2 Phillips screwdriver to tighten the screw on each of the two mounting brackets. Do not overtighten: the maximum installation torque is 0.4 Newton-Meter.

3.4: Shark® 100T Transducer Installation

The Shark® 100T Transducer model is installed using DIN Rail Mounting.

Specs for DIN Rail Mounting

International Standards DIN 46277-3

DIN Rail (Slotted) Dimensions: 7.55mm x 35mm

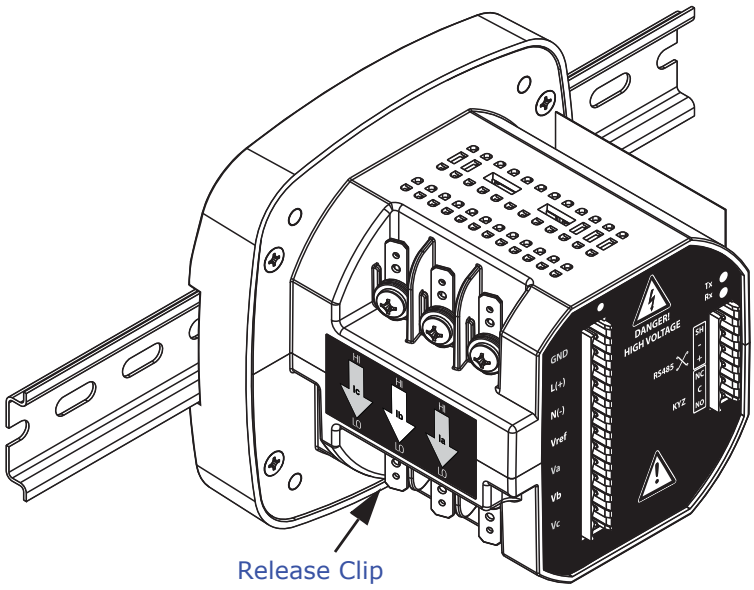


Figure 3.9: DIN Rail Mounting

DIN RAIL INSTALLATION STEPS:

1. Slide top groove of meter onto the DIN Rail.

2. Press gently until the meter clicks into place.

NOTE: If mounting with the DIN Rail provided, use the Black Rubber Stoppers (also provided). See Figure 3.10.

TO REMOVE METER FROM DIN RAIL:

Pull down on Release clip to detach the unit from the DIN rail.

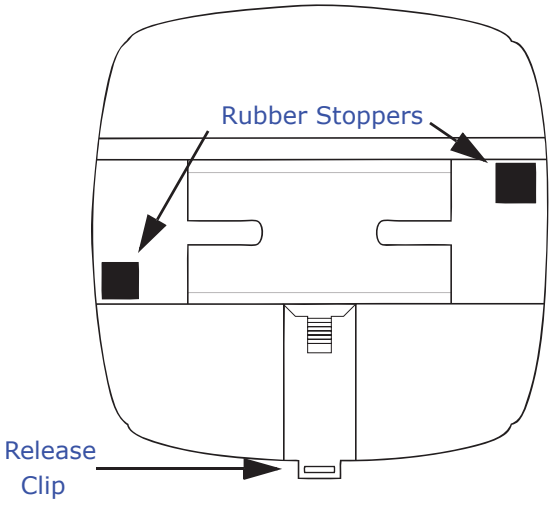


Figure 3.10: DIN Rail Detail

NOTE ON DIN RAILS:

DIN rails are commonly used as a mounting channel for most terminal blocks, control devices, circuit protection devices and PLCs. DIN Rails are made of electrolytically plated cold rolled steel but are also available in aluminum, PVC, stainless steel and copper.

This page intentionally left blank.

4: Electrical Installation

4.1: Considerations When Installing Meters

Installation of the Shark® 100/50 meter must be performed only by qualified personnel who follow standard safety precautions during all procedures. Those personnel should have appropriate training and experience with high voltage devices. Appropriate safety gloves, safety glasses and protective clothing is recommended.

During normal operation of the Shark® 100/50 meter, dangerous voltages flow through many parts of the meter, including: Terminals and any connected CTs (current transformers) and PTs (potential transformers), all I/O modules (inputs and outputs) and their circuits.

All Primary and Secondary circuits can, at times, produce lethal voltages and currents. Avoid contact with any current-carrying surfaces.

Do not use the meter or any I/O Output Device for primary protection or in an energy-limiting capacity. The meter can only be used as secondary protection.

Do not use the meter for applications where failure of the meter may cause harm or death.

Do not use the meter for any application where there may be a risk of fire.

All meter terminals should be inaccessible after installation.

Do not apply more than the maximum voltage the meter or any attached device can withstand. Refer to meter and/or device labels and to the Specifications for all devices before applying voltages.

Do not HIPOT/Dielectric test any Outputs, Inputs or Communications terminals.

EIG requires the use of Fuses for voltage leads and power supply and Shorting Blocks to prevent hazardous voltage conditions or damage to CTs, if the meter needs to be removed from service. CT grounding is optional, but recommended.
NOTE: The current inputs are only to be connected to external current transformers provided by the installer. The CT's shall be Listed or Approved and rated for the current of the meter used.

L'installation des compteurs de Shark 50/50B/100/100B doit être effectuée seulement par un personnel qualifié qui suit les normes relatives aux précautions de sécurité pendant toute la procédure. Le personnel doit avoir la formation appropriée et l'expérience avec les appareils de haute tension. Des gants de sécurité, des verres et des vêtements de protection appropriés sont recommandés.

AVERTISSEMENT! Pendant le fonctionnement normal du compteur Shark 50/50B/100/100B des tensions dangereuses suivant de nombreuses pièces, notamment, les bornes et tous les transformateurs de courant branchés, les transformateurs de tension, toutes les sorties, les entrées et leurs circuits. **Tous les circuits secondaires et primaires peuvent parfois produire des tensions de létal et des courants. Évitez le contact avec les surfaces sous tensions. Avant de faire un travail dans le compteur, assurez-vous d'éteindre l'alimentation et de mettre tous les circuits branchés hors tension.**

Ne pas utiliser les compteurs ou sorties d'appareil pour une protection primaire ou capacité de limite d'énergie. Le compteur peut seulement être utilisé comme une protection secondaire.

Ne pas utiliser le compteur pour application dans laquelle une panne de compteur peut causer la mort ou des blessures graves.

Ne pas utiliser le compteur ou pour toute application dans laquelle un risque d'incendie est susceptible.

Toutes les bornes de compteur doivent être inaccessibles après l'installation.

Ne pas appliquer plus que la tension maximale que le compteur ou appareil relatif peut résister. Référez-vous au compteur ou aux étiquettes de l'appareil et les spécifications de tous les appareils avant d'appliquer les tensions. Ne pas faire de test HIPOT/diélectrique, une sortie, une entrée ou un terminal de réseau.

Les entrées actuelles doivent seulement être branchées aux transformateurs externes actuels.

EIG nécessite l'utilisation de les fusibles pour les fils de tension et alimentations électriques, ainsi que des coupe-circuits pour prévenir les tensions dangereuses ou endommagements de transformateur de courant si l'unité Shark 50/50B/100/100B

doit être enlevée du service. Un côté du transformateur de courant doit être mis à terre.

NOTE: les entrées actuelles doivent seulement être branchées dans le transformateur externe actuel par l'installateur. Le transformateur de courant doit être approuvé ou certifié et déterminé pour le compteur actuel utilisé.

IMPORTANT!

IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.

- THERE IS NO REQUIRED PREVENTIVE MAINTENANCE OR INSPECTION NECESSARY FOR SAFETY. HOWEVER, ANY REPAIR OR MAINTENANCE SHOULD BE PERFORMED BY THE FACTORY.

DISCONNECT DEVICE: The following part is considered the equipment disconnect device. A SWITCH OR CIRCUIT-BREAKER SHALL BE INCLUDED IN THE END-USE EQUIPMENT OR BUILDING INSTALLATION. THE SWITCH SHALL BE IN CLOSE PROXIMITY TO THE EQUIPMENT AND WITHIN EASY REACH OF THE OPERATOR. THE SWITCH SHALL BE MARKED AS THE DISCONNECTING DEVICE FOR THE EQUIPMENT.

IMPORTANT! SI L'ÉQUIPEMENT EST UTILISÉ D'UNE FAÇON NON SPÉCIFIÉE PAR LE FABRICANT, LA PROTECTION FOURNIE PAR L'ÉQUIPEMENT PEUT ÊTRE ENDOMMAGÉE.

NOTE: Il N'Y A AUCUNE MAINTENANCE REQUISE POUR LA PRÉVENTION OU INSPECTION NÉCESSAIRE POUR LA SÉCURITÉ. CEPENDANT, TOUTE RÉPARATION OU MAINTENANCE DEVRAIT ÊTRE RÉALISÉE PAR LE FABRICANT.

DÉBRANCHEMENT DE L'APPAREIL : la partie suivante est considérée l'appareil de débranchement de l'équipement.
UN INTERRUPTEUR OU UN DISJONCTEUR DEVRAIT ÊTRE INCLUS DANS L'UTILISATION FINALE DE L'ÉQUIPEMENT OU L'INSTALLATION. L'INTERRUPTEUR DOIT ÊTRE DANS UNE PROXIMITÉ PROCHE DE

L'ÉQUIPEMENT ET A LA PORTÉE DE L'OPÉRATEUR. L'INTERRUPTEUR DOIT AVOIR LA MENTION DÉBRANCHEMENT DE L'APPAREIL POUR L'ÉQUIPEMENT.

4.2: CT Leads Terminated to Meter

The Shark® 100/50 meter is designed to have current inputs wired in one of three ways. Figure 4.1 shows the most typical connection where CT Leads are terminated to the meter at the current gills. This connection uses nickel-plated brass studs (current gills) with screws at each end. This connection allows the CT wires to be terminated using either an “O” or a “U” lug. Tighten the screws with a #2 Phillips screwdriver. The maximum installation torque is 1 Newton-Meter.

Other current connections are shown in Figures 4.2 and 4.3. Voltage and RS485/KYZ Connection is shown in Figure 4.4.

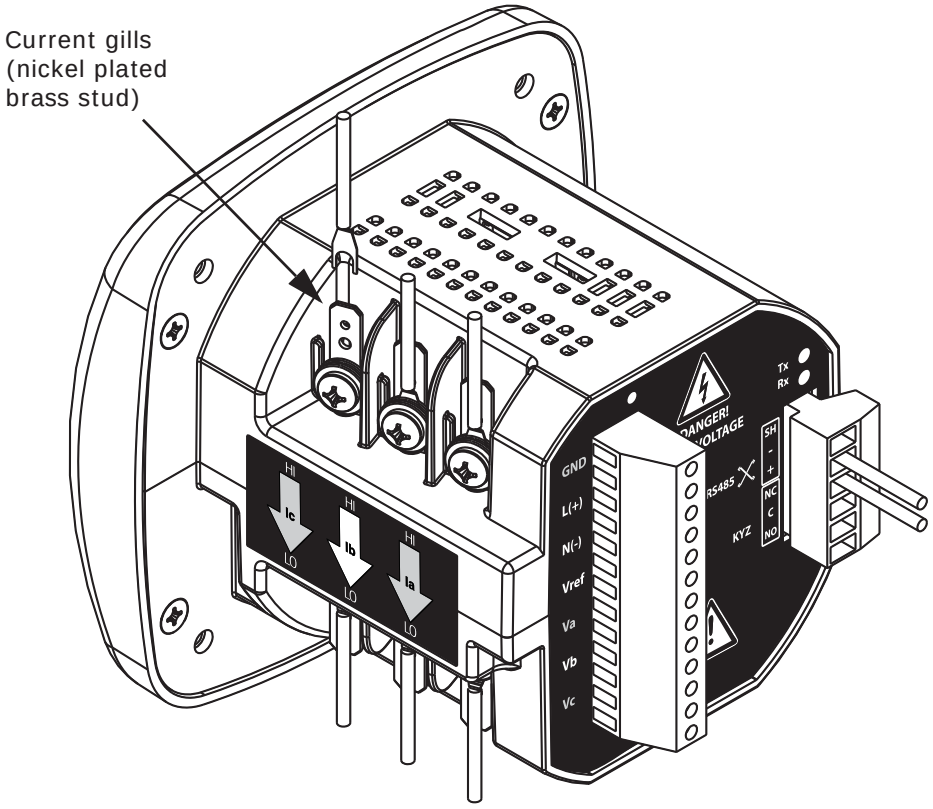


Figure 4.1: CT Leads terminated to Meter, #8 Screw for Lug Connection

Wiring diagrams are shown in Section 4.8 of this chapter.

Communication connections are detailed in Chapter 5.

NOTE: Figures 4.1 - 4.4 show the back of a meter with the 485P option. If your meter is a Shark® 100B or is a Shark® 100 with the INP10 option, you will see an RJ45 port and KYZ Pulse Output on the back of the meter. If your meter is a Shark® 50B, you will see both an RS485 and RJ45 port, but no KYZ Pulse Output.

4.3: CT Leads Pass Through (No Meter Termination)

The second method allows the CT wires to pass through the CT inputs without terminating at the meter. In this case, remove the current gills and place the CT wire directly through the CT opening. The opening accommodates up to 0.177" / 4.5mm maximum diameter CT wire.

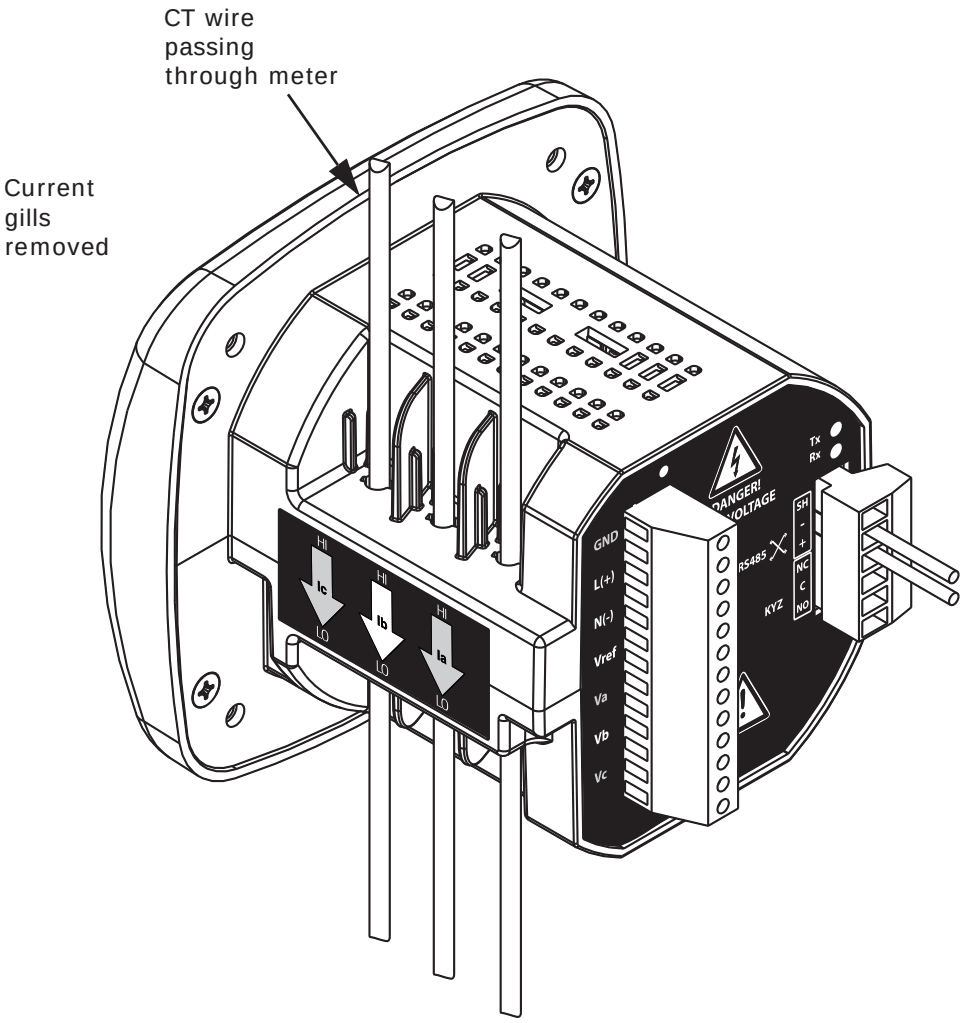


Figure 4.2: Pass Through Wire Electrical Connection

4.4: Quick Connect Crimp-on Terminations

For quick termination or for portable applications, 0.25” quick connect crimp-on connectors can also be used.

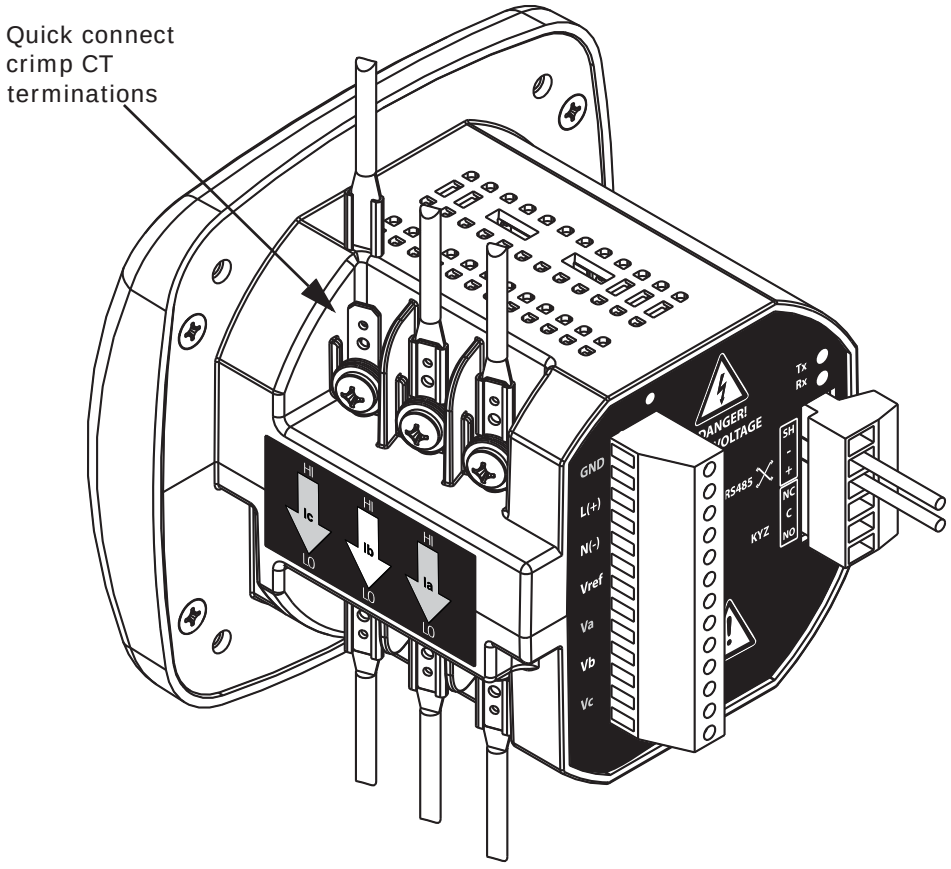


Figure 4.3: Quick Connect Electrical Connection

4.5: Voltage and Power Supply Connections

Voltage inputs are connected to the back of the unit via wire connectors. The connectors accommodate AWG# 12-26/(0.129 - 3.31)mm^2. The diagram below shows the back of a meter with the RS485P Option. If your meter has the INP10 option or is a Shark® 50B meter, the back will look somewhat different.

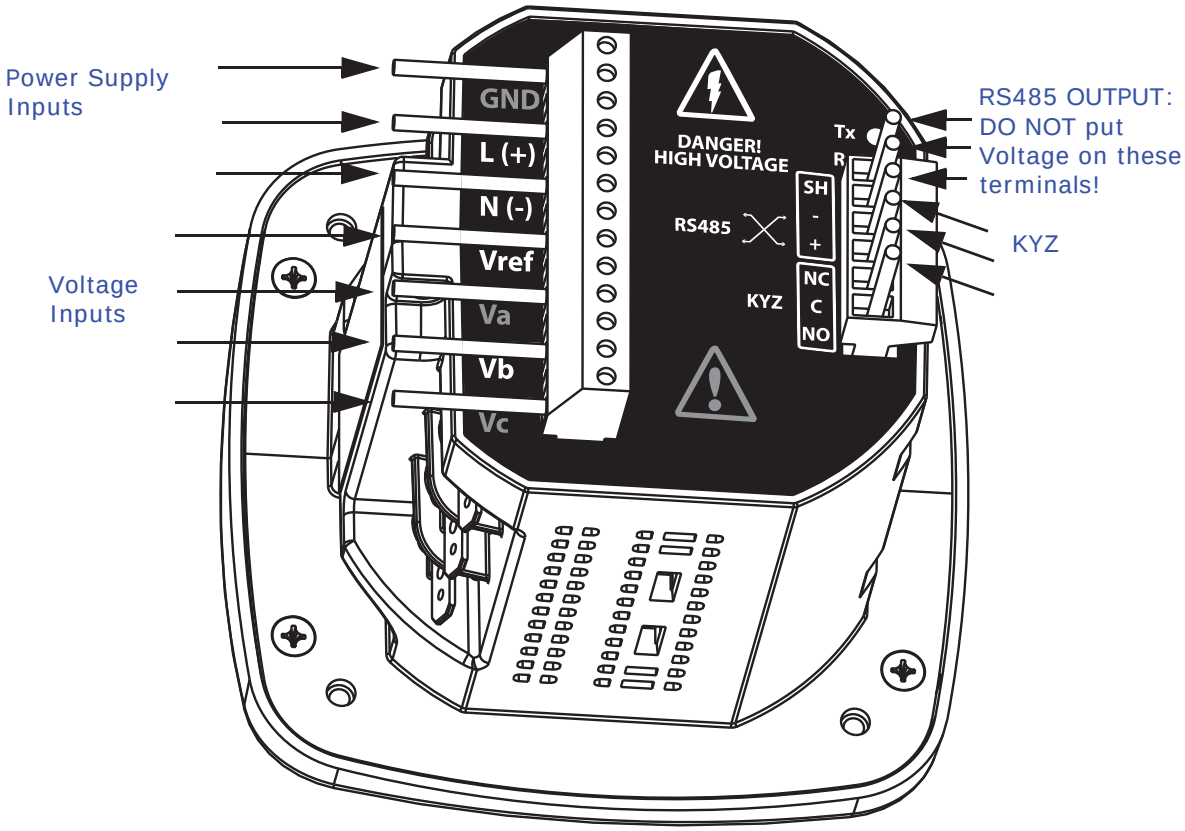


Figure 4.4: Meter Connection

4.6: Ground Connections

The meter's Ground terminals should be connected directly to the installation's protective earth ground. Use AWG# 12/2.5 mm^2 wire for this connection.

4.7: Voltage Fuses

EIG requires the use of fuses on each of the sense Voltages and on the control power.

- Use a 0.1 Amp fuse on each Voltage input.

- Use a 3 Amp Slow Blow fuse on the power supply.
  EIG offers the EI-CP Panel meter protective fuse kit, which can be ordered from EIG's webstore: www.electroind.com/store. Select Fuse Kits from the list on the left side of the webpage.

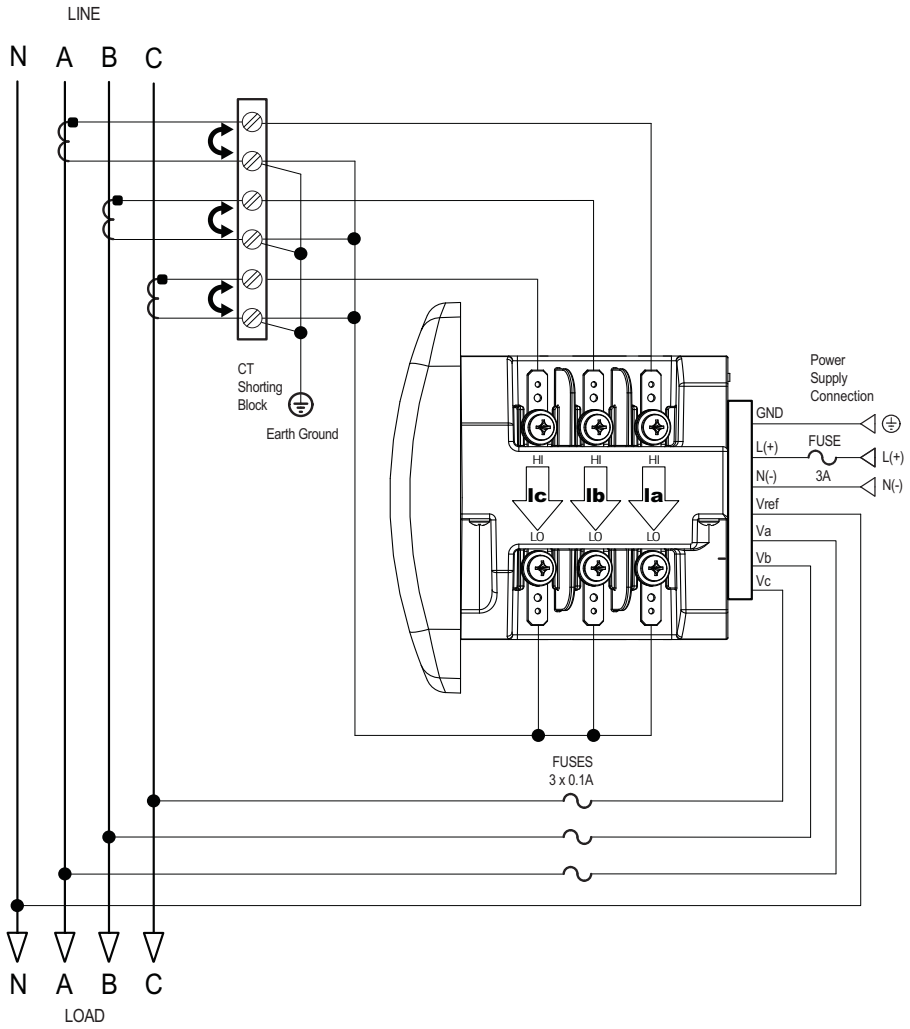
4.8: Electrical Connection Diagrams

The following pages contain electrical connection diagrams for the Shark® 100/50 meter. Choose the diagram that best suits your application. Be sure to maintain the CT polarity when wiring.

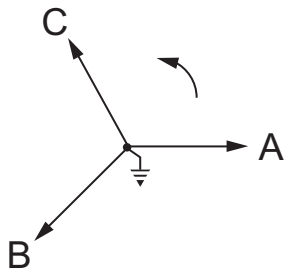
The diagrams are presented in the following order:

1. Three Phase, Four-Wire System Wye with Direct Voltage, 3 Element
   a. Example of Dual-Phase Hookup
   b. Example of Single Phase Hookup
2. Three Phase, Four-Wire System Wye with Direct Voltage, 2.5 Element
3. Three-Phase, Four-Wire Wye with PTs, 3 Element
4. Three-Phase, Four-Wire Wye with PTs, 2.5 Element
5. Three-Phase, Three-Wire Delta with Direct Voltage
6. Three-Phase, Three-Wire Delta with 2 PTs
7. Three-Phase, Three-Wire Delta with 3 PTs
8. Current Only Measurement (Three Phase)
9. Current Only Measurement (Dual Phase)
10. Current Only Measurement (Single Phase)

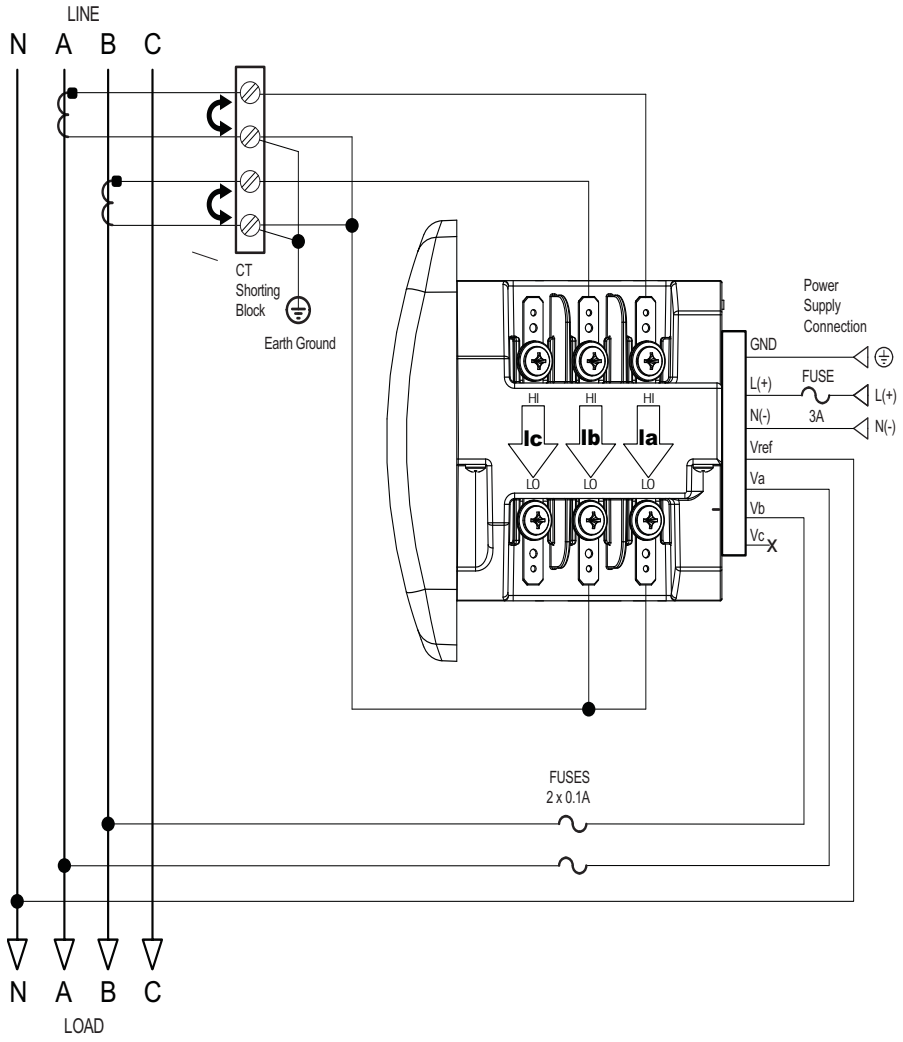
1. Service: WYE, 4-Wire with No PTs, 3 CTs



Select: " 3 EL WYE " (3 Element Wye) from the Shark® meter's Front Panel Display. (See Chapter 6.)

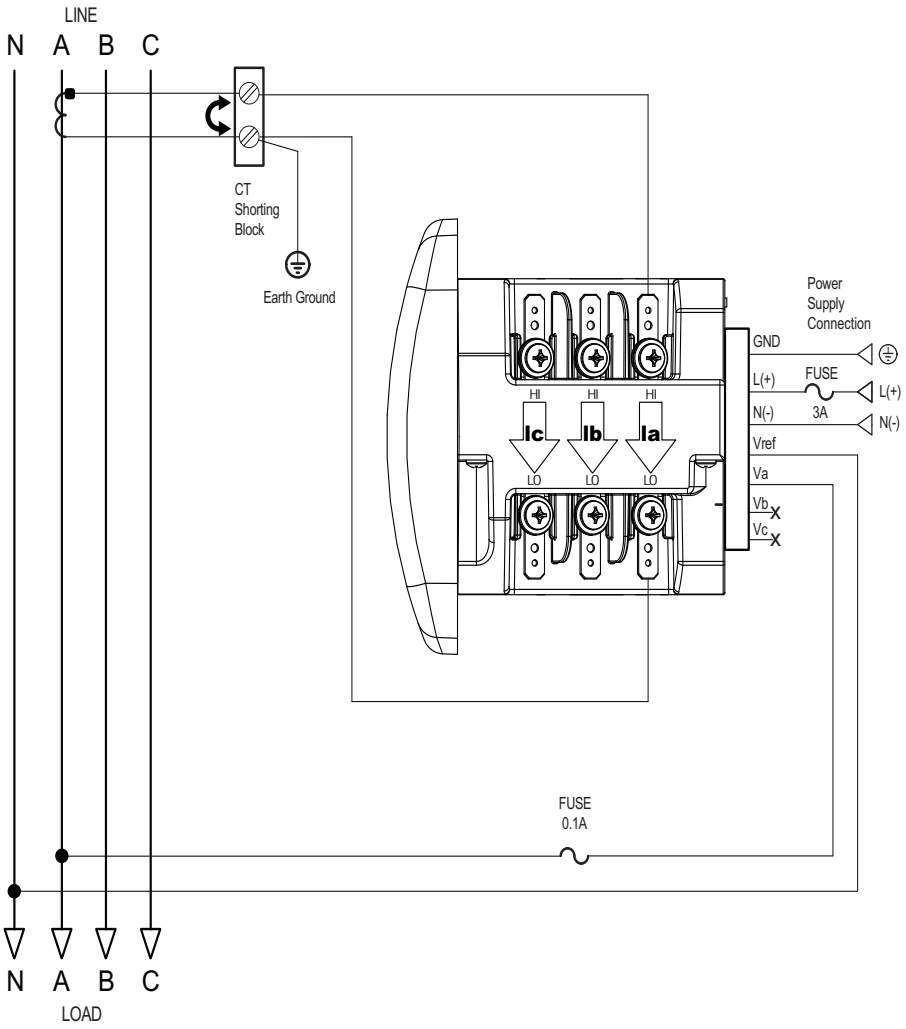


1a. Example of Dual Phase Hookup



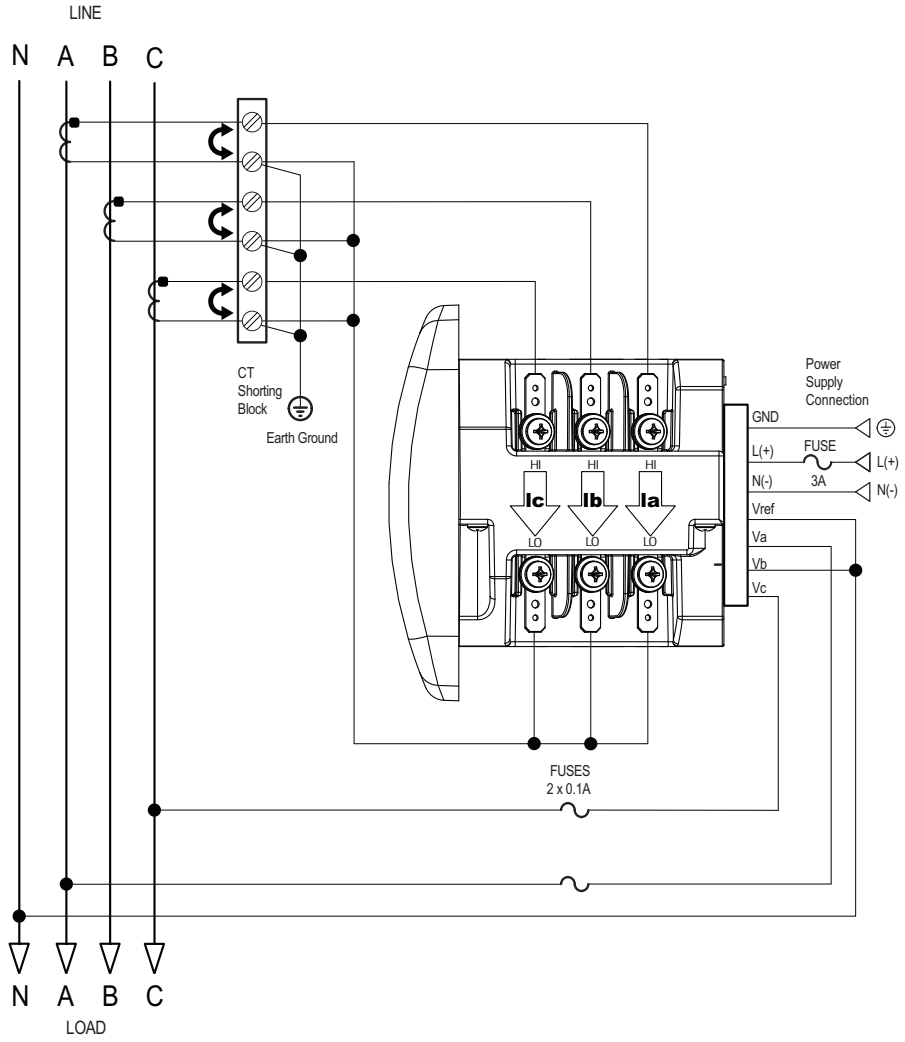
Select: " 3 EL WYE " (3 Element Wye) from the Shark® meter's Front Panel Display. (See Chapter 6.)

1b. Example of Single Phase Hookup

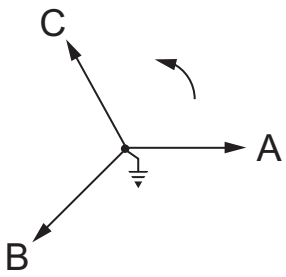


Select: " 3 EL WYE " (3 Element Wye) from the Shark® meter's Front Panel Display. (See Chapter 6.)

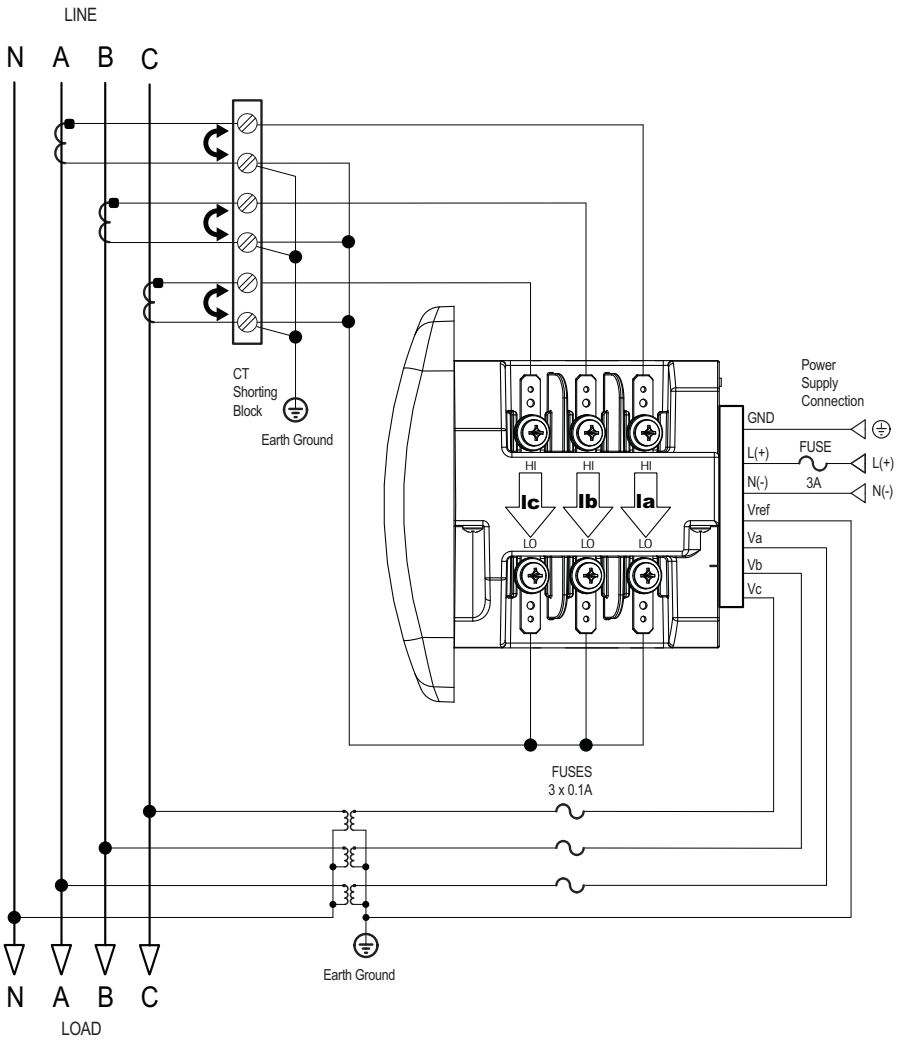
2. Service: 2.5 Element WYE, 4-Wire with No PTs, 3 CTs



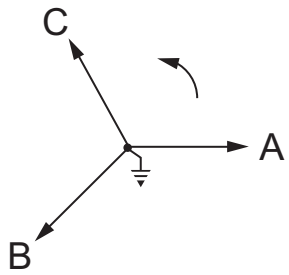
Select: "2.5 EL WYE" (2.5 Element Wye) from the Shark® meter's Front Panel Display. (See Chapter 6.)



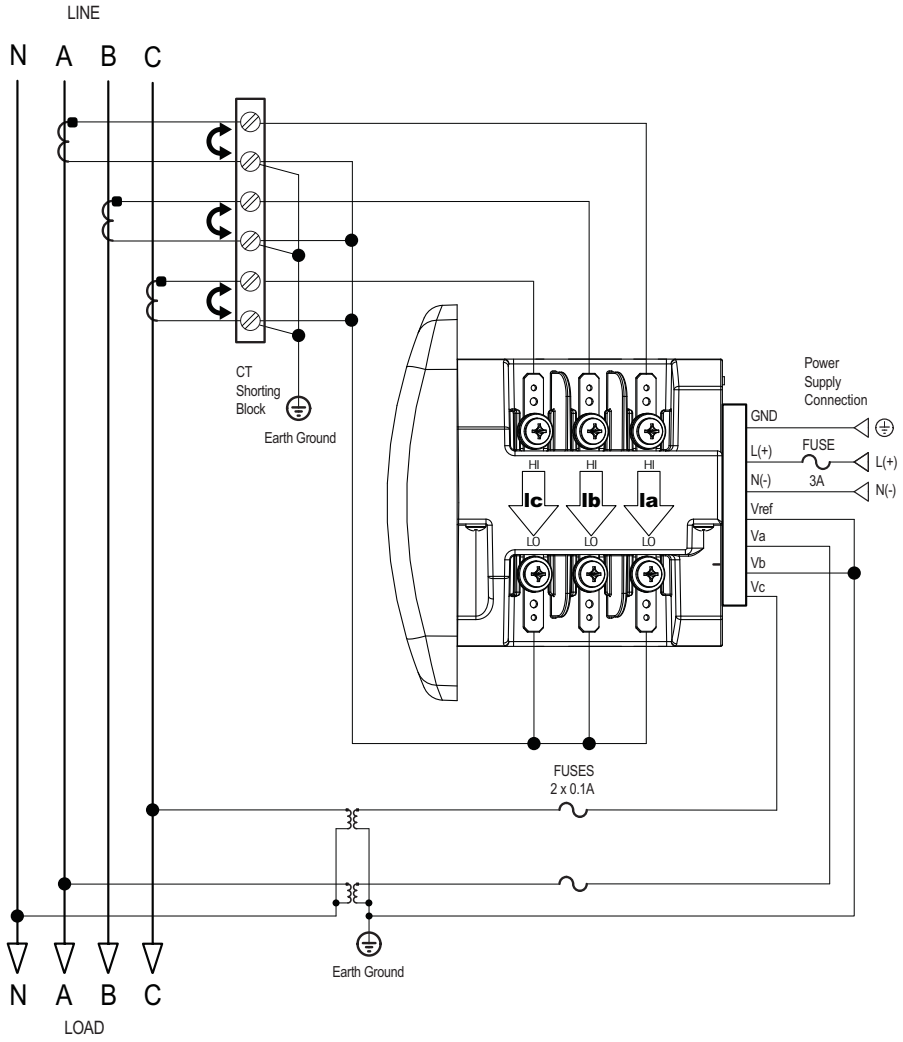
3. Service: WYE, 4-Wire with 3 PTs, 3 CTs



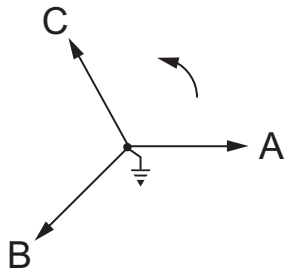
Select: "3 EL WYE" (3 Element Wye) from the Shark® meter's Front Panel Display. (See Chapter 6.)



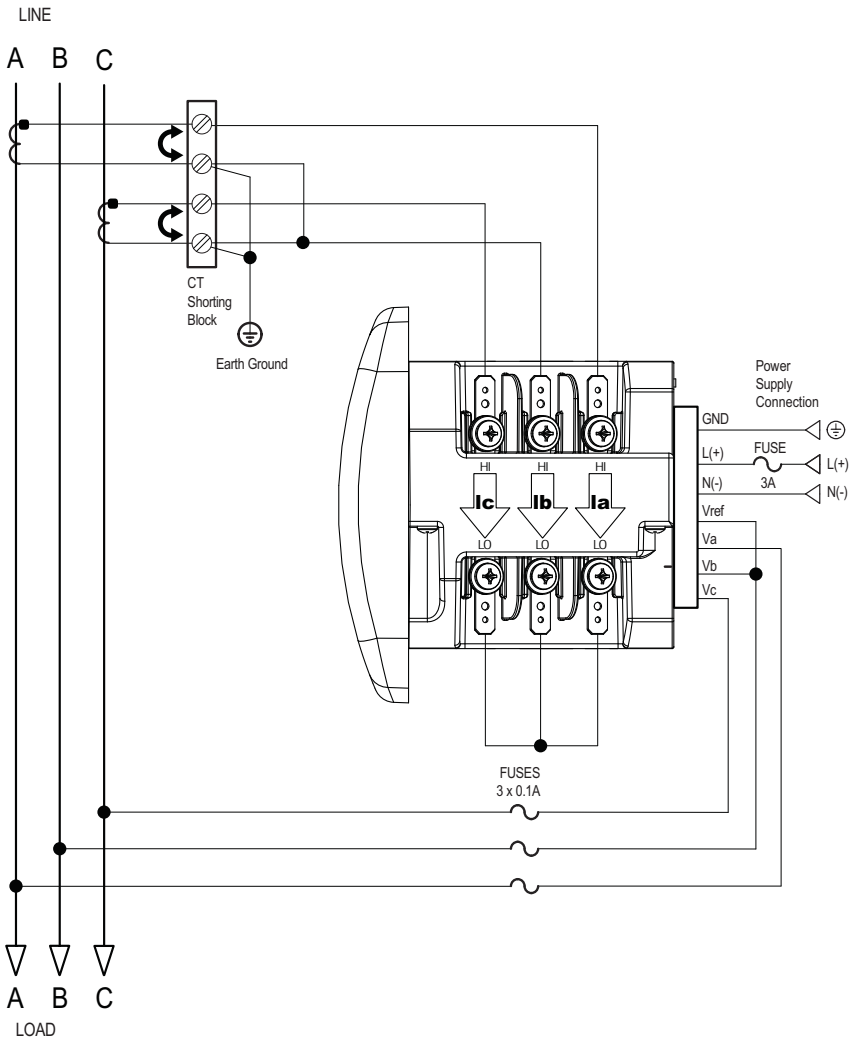
4. Service: 2.5 Element WYE, 4-Wire with 2 PTs, 3 CTs



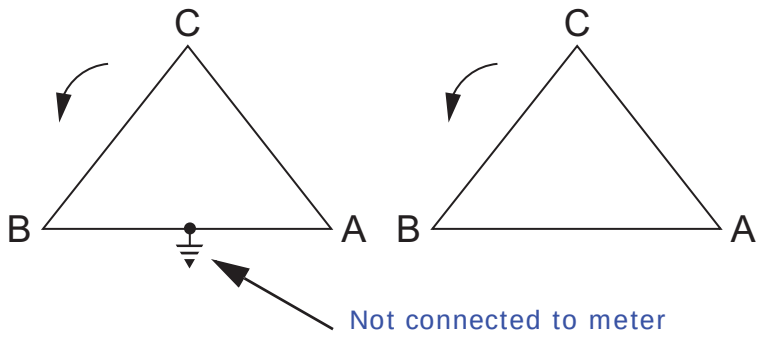
Select: "2.5 EL WYE" (2.5 Element Wye) from the Shark® meter's Front Panel Display. (See Chapter 6.)



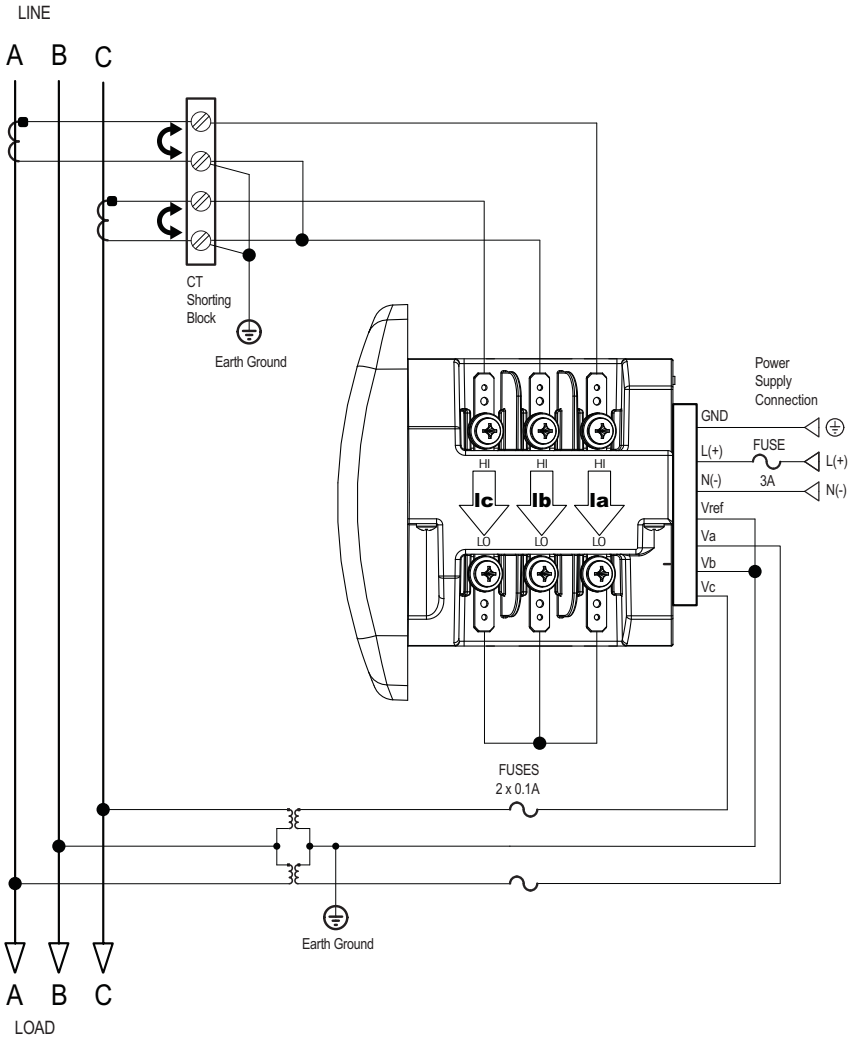
5. Service: Delta, 3-Wire with No PTs, 2 CTs



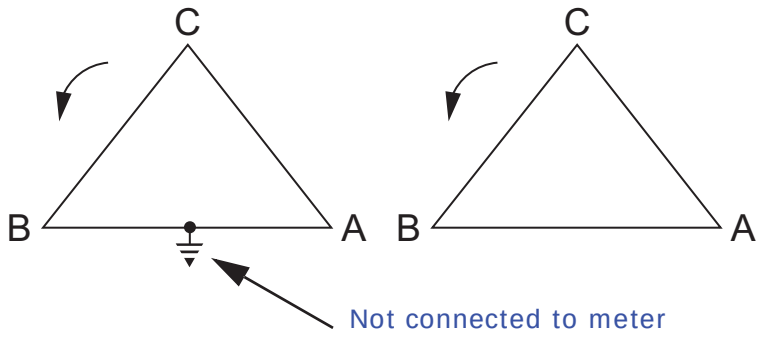
Select: "2 CT DEL" (2 CT Delta) from the Shark® meter's Front Panel Display. (See Chapter 6.)



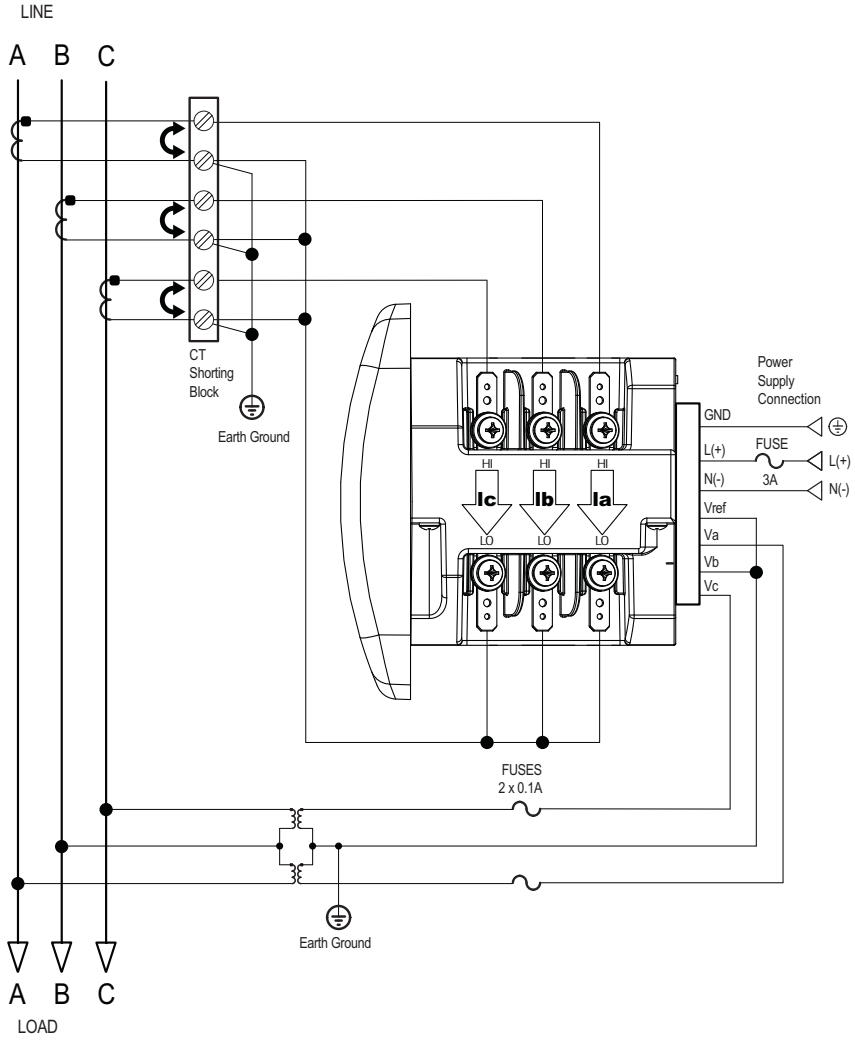
6. Service: Delta, 3-Wire with 2 PTs, 2 CTs



Select: "2 CT DEL" (2 CT Delta) from the Shark® meter's Front Panel Display. (See Chapter 6.)

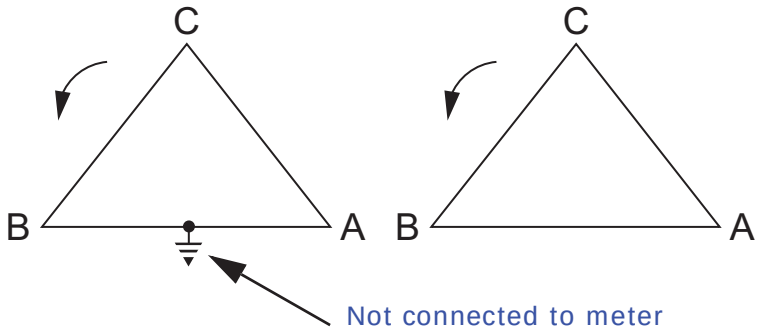


7. Service: Delta, 3-Wire with 2 PTs, 3 CTs

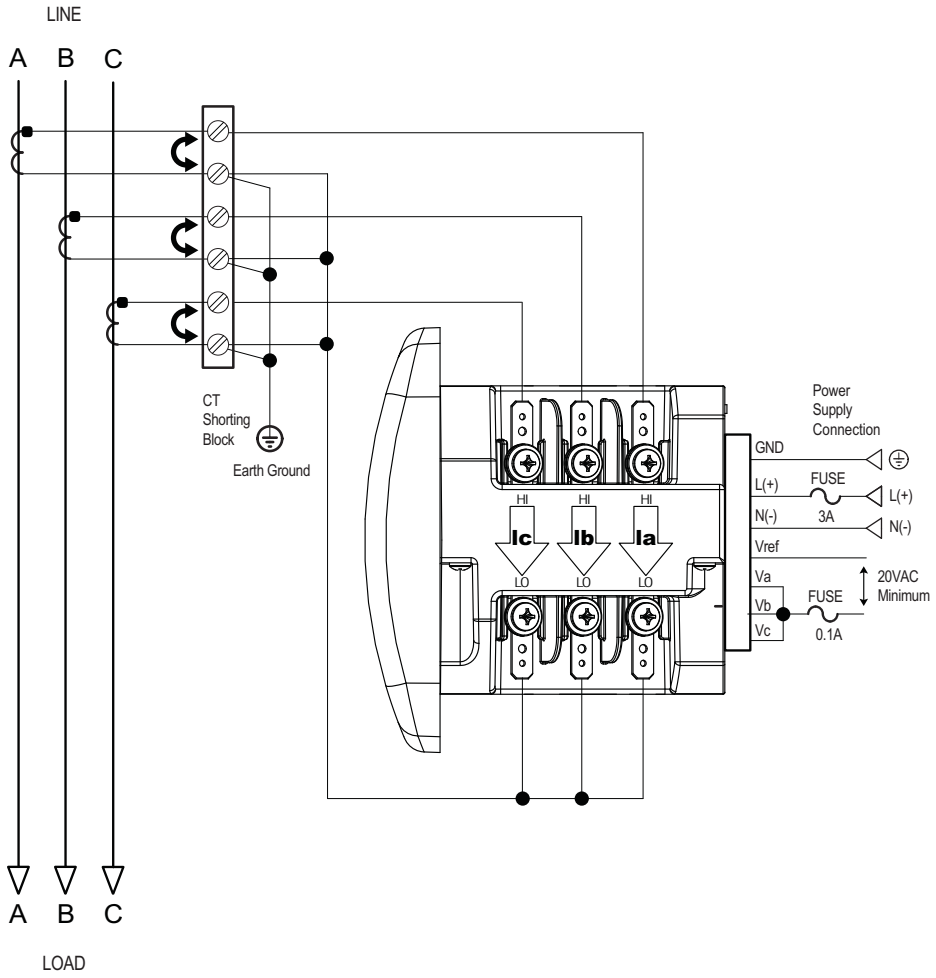


Select: "2 CT DEL" (2 CT Delta) from the Shark® meter's Front Panel Display. (See Chapter 6.)

NOTE: The third CT for hookup is optional, and is used only for current measurement.

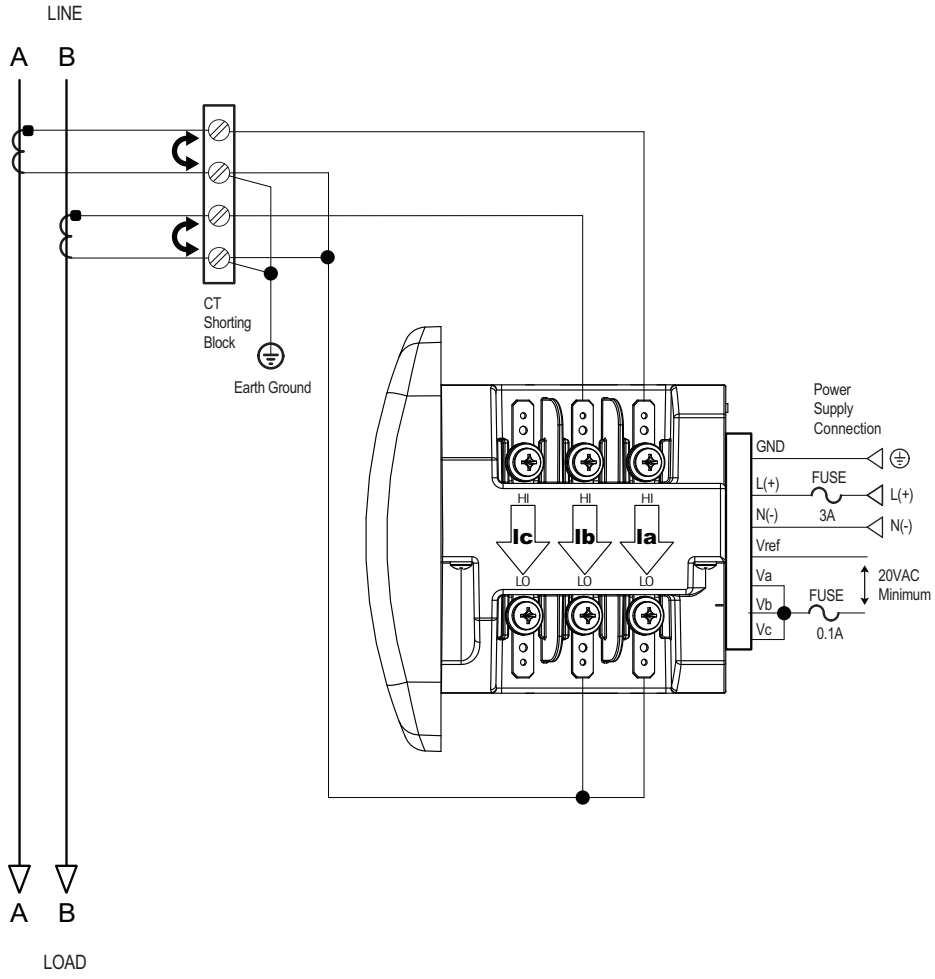


8. Service: Current Only Measurement (Three Phase)



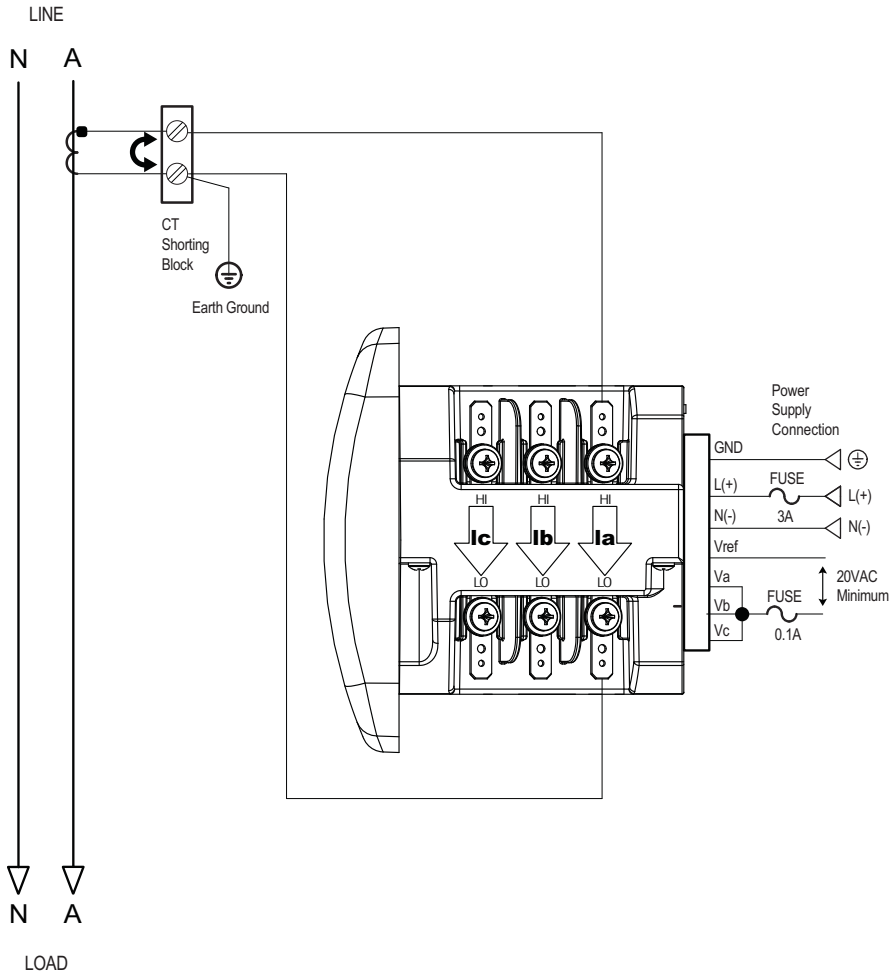
Select: "3 EL WYE" (3 Element Wye) from the Shark® meter's Front Panel Display. (See Chapter 6.)

9. Service: Current Only Measurement (Dual Phase)



Select: "3 EL WYE" (3 Element Wye) from the Shark® meter's Front Panel Display. (See Chapter 6.)

10. Service: Current Only Measurement (Single Phase)



Select: "3 EL WYE" (3 Element Wye) from the Shark® meter's Front Panel Display. (See Chapter 6.)

NOTE: The diagram shows a connection to Phase A, but you can also connect to Phase B or Phase C.

4.9: Extended Surge Protection for Substation Instrumentation

EIG offers a surge protector for applications with harsh electrical conditions. The surge protector is EI-MSB10-400 and it can be ordered from EIG's webstore: www.electroind.com/store.

The EI-MSB10-400 surge protector is designed to protect sensitive equipment from the damaging effects of lightning strikes and/or industrial switching surges in single phase AC networks up to 320VAC (L-N / L-G), and DC networks up to 400 VDC. The protectors are ideal for metering systems, RTUs, PLCs and protective relays. They are used specifically to extend the life and increase reliability of critical control apparatus.

For best protection, it is recommended to use two protectors. These will protect the instrument on the line inputs and on the reference input to ground. The protectors have LED indication to annunciate when the protection has worn out.

The EI-MSB10-400 is connected by wires in parallel with the network to be protected. It can be easily mounted on a wall or plate with self-adhesive tape.

See the wiring diagram below.

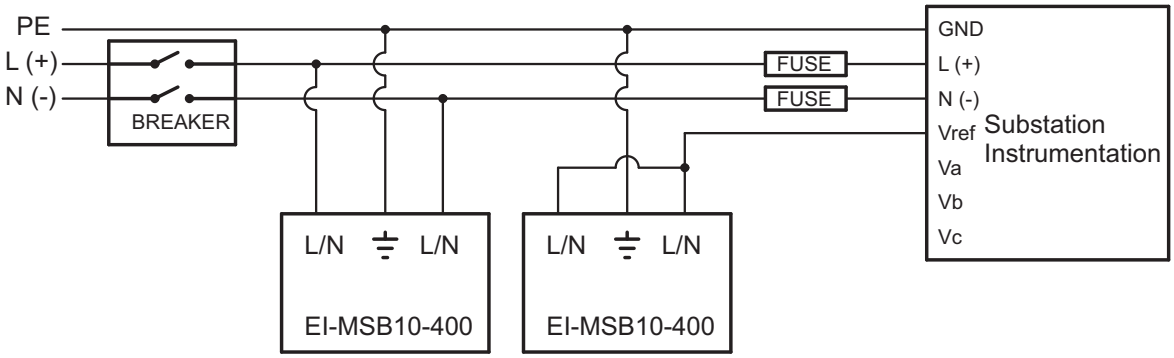


Figure 4.5: Wiring Schematic for Extended Surge Suppression Suitable for Substation Instrumentation

This page intentionally left blank.

5: Communication Installation

The Shark® 100/50 meter is designed in four forms that each have communication capability. The first form uses RS485 serial communication. This allows the meter to be wired in a daisy chain connection along with other meters, and to communicate data back via serial protocol. The available protocols are Modbus RTU/ASCII or DNP 3.0.

NOTE: The RS485 option is the only communication mode available for the Shark® 50 meter.

The second form of the meter is the Shark® 100 - INP10. This meter provides similar communication capability, but communicates over a 10/100BaseT Modbus TCP/IP Ethernet connection.

The third form of the meter is the Shark® 100B. This unit adds the capability of communicating over BACnet/IP. This allows the meter to act as a BACnet server and to transfer data to a BACnet client over an IP architecture. This meter also provides a basic web interface and a Modbus TCP/IP connection.

The fourth form of the meter is the Shark® 50B. This unit adds the capability of communicating BACnet MS/TP through serial RS485. This meter also provides a basic web interface and a Modbus TCP/IP connection.

5.1: Shark® 100/50 Meter Serial Based Communication

The basic Shark® 100 meter provides two independent Communication ports. The first port, Com 1, is an optical IrDA port. The second port, Com 2, provides RS485 communication speaking Modbus ASCII, Modbus RTU and DNP 3.0 (V3 and V4) protocols. The Shark® 100B meter and Shark® 100 with the INP10 option have an RJ45 port instead of an RS485 port (see Section 5.3). The Shark® 50 meter has the RS485 port as an option, but no IrDA port. The Shark® 50B meter has both RS485 and an Ethernet option, but no IrDA port; its RS485 port is dedicated to BACnet communication, and its Ethernet port to Modbus TCP/IP communication.

5.1.1: IrDA Port (Com 1)

The Shark® 100 meter's Com 1 IrDA port is on the face of the meter. The IrDA port allows the unit to be set up and programmed without the need for a communication cable. Just point at the meter with an IrDA-enabled PC to configure it.

Figure 5.1: IrDA Communication

Com 1 (IrDA port) settings

Address: 1

Baud Rate: 57.6k

Protocol: Modbus ASCII

Additional settings are configured using Communicator EXT™ software. Refer to the *Communicator EXT™ 4.0 and MeterManager EXT Software User Manual* for instructions. EIG recommends the CAB6490 USB to IrDA adapter, which can be ordered from the EIG webstore: www.electroind.com/store. Select Cables & Accessories from the left side of the webpage.

5.1.2: RS485/KYZ Output Com 2 (485P Option)

The 485P Option provides a combination RS485 and KYZ Pulse Output for pulsing energy values. The RS485/KYZ Combo is located on the terminal section of the meter.

NOTES:

- The Shark® 100B meter and Shark® 100 meters with the INP10 option also have a KYZ pulse output, but do not have an RS485 option (see Section 5.2 and Chapter 7).
- The Shark® 50B meter has a an RS485 port, standard, which is a dedicated BACnet MS/TP protocol port. It does not have a KYZ pulse.

See Section 2.2 for the KYZ Output specifications, and Section 6.3.1 for pulse constants.

The Shark® 100/50/50B meter's RS485 can be programmed with the buttons on the face of the meter or by using Communicator EXT™ 4.0 software. See Chapter 6 for instructions on these two modes.

Standard RS485 Port Settings

Address: 001 to 247

Baud Rate: 9600, 19200, 38400 or 57600

Protocol: Modbus RTU, Modbus ASCII, DNP 3.0 (DNP 3.0 is available with the Shark® 100 meter's V3 and V4 only.)

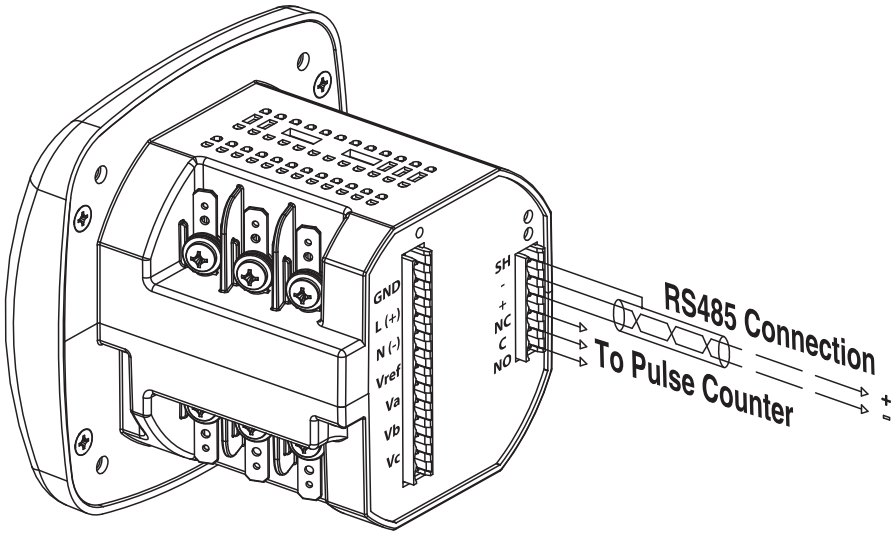


Figure 5.2: 485P Option with RS485 Communication

RS485 allows you to connect one or multiple Shark® 100/50 meters to a PC or other device, at either a local or remote site. All RS485 connections are viable for up to 4000 feet (1219.20 meters).

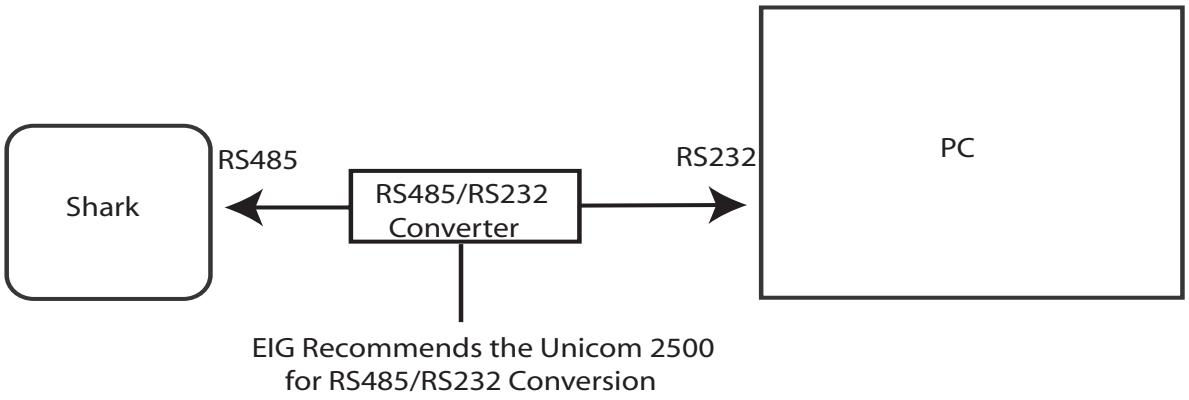


Figure 5.3: Shark® 100/50 Connected to PC via RS485

As shown in Figure 5.3, to connect a Shark® 100/50 to a PC, you need to use an RS485 to RS232 converter, such as EIG's Unicom 2500. See Section 5.1.2.1 for information on using the Unicom 2500 with the Shark® 100/50.
Figure 5.4 shows the detail of a 2-wire RS485 connection.

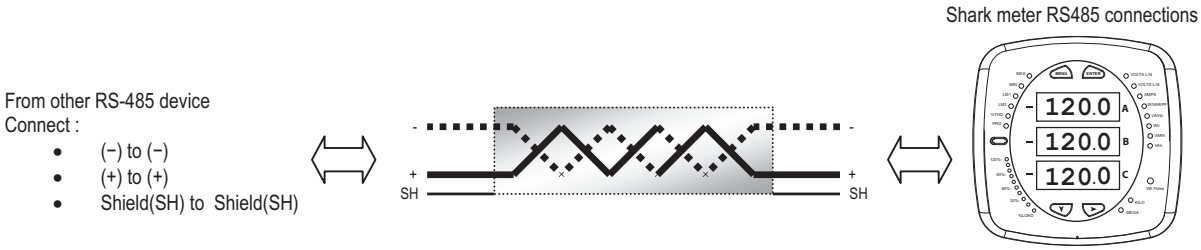


Figure 5.4: 2-wire RS485 Connection

NOTES For All RS485 Connections:

- Use a shielded twisted pair cable 22 AWG (0.33 mm2) or larger, grounding the shield at one end only.
- Establish point-to-point configurations for each device on a RS485 bus: connect (+) terminals to (+) terminals; connect (-) terminals to (-) terminals.

- You may connect up to 31 meters on a single bus using RS485. Before assembling the bus, each meter must be assigned a unique address: refer to Chapter 9 of the *Communicator EXT™ 4.0 and MeterManager EXT Software User Manual* for instructions.
- Protect cables from sources of electrical noise.
- Avoid both “Star” and “Tee” connections (see Figure 5.6).
- No more than two cables should be connected at any one point on an RS485 network, whether the connections are for devices, converters, or terminal strips.
- Include all segments when calculating the total cable length of a network. If you are not using an RS485 repeater, the maximum length for cable connecting all devices is 4000 feet (1219.20 meters).
- Connect shield to RS485 Master and individual devices as shown in Figure 5.5. You may also connect the shield to earth-ground at one point.
- Termination Resistors (RT) may be needed on both ends of longer length transmission lines. However, since the meter has some level of termination internally, Termination Resistors may not be needed. When they are used, the value of the Termination Resistors is determined by the electrical parameters of the cable.

Figure 5.5 shows a representation of an RS485 Daisy Chain connection. Refer to Section 5.1.2.1 for details on RS485 connection for the Unicom 2500.

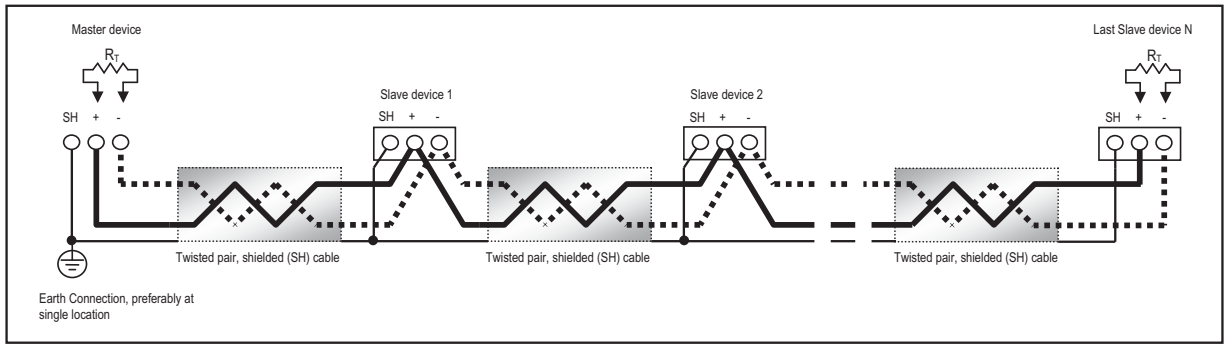


Figure 5.5: RS485 Daisy Chain Connection

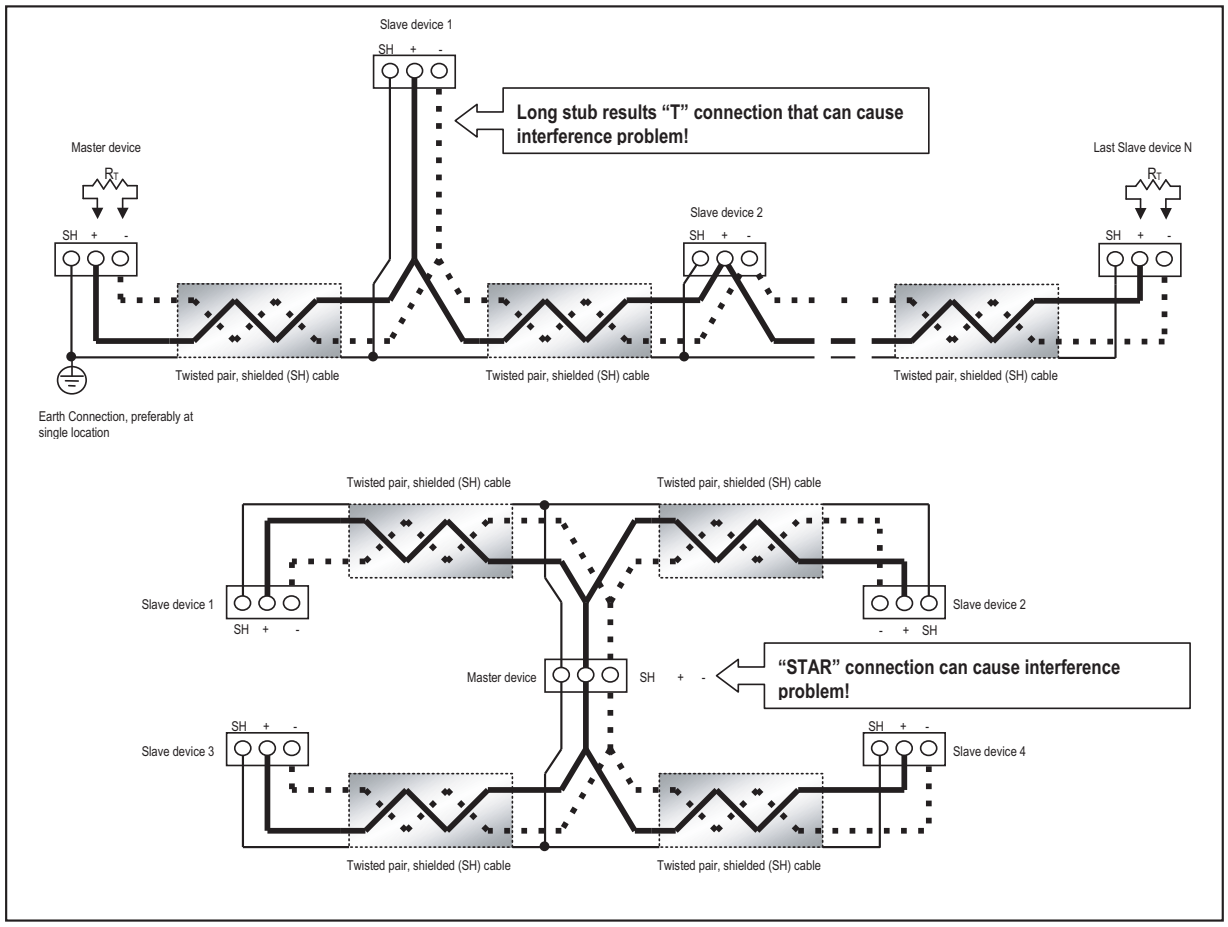


Figure 5.6: Incorrect "T" and "Star" Topologies

5.1.2.1: Using the Unicom 2500

The Unicom 2500 provides RS485/RS232 conversion. In doing so it allows a Shark® 100/50 with the RS485 option to communicate with a PC. See the *Unicom 2500 Installation and Operation Manual* for additional information. You can order the Unicom 2500 from EIG's webstore: www.electroind.com/store. Select Communication Products from the left side of the webpage.

Figure 5.7 illustrates the Unicom 2500 connections for RS485.

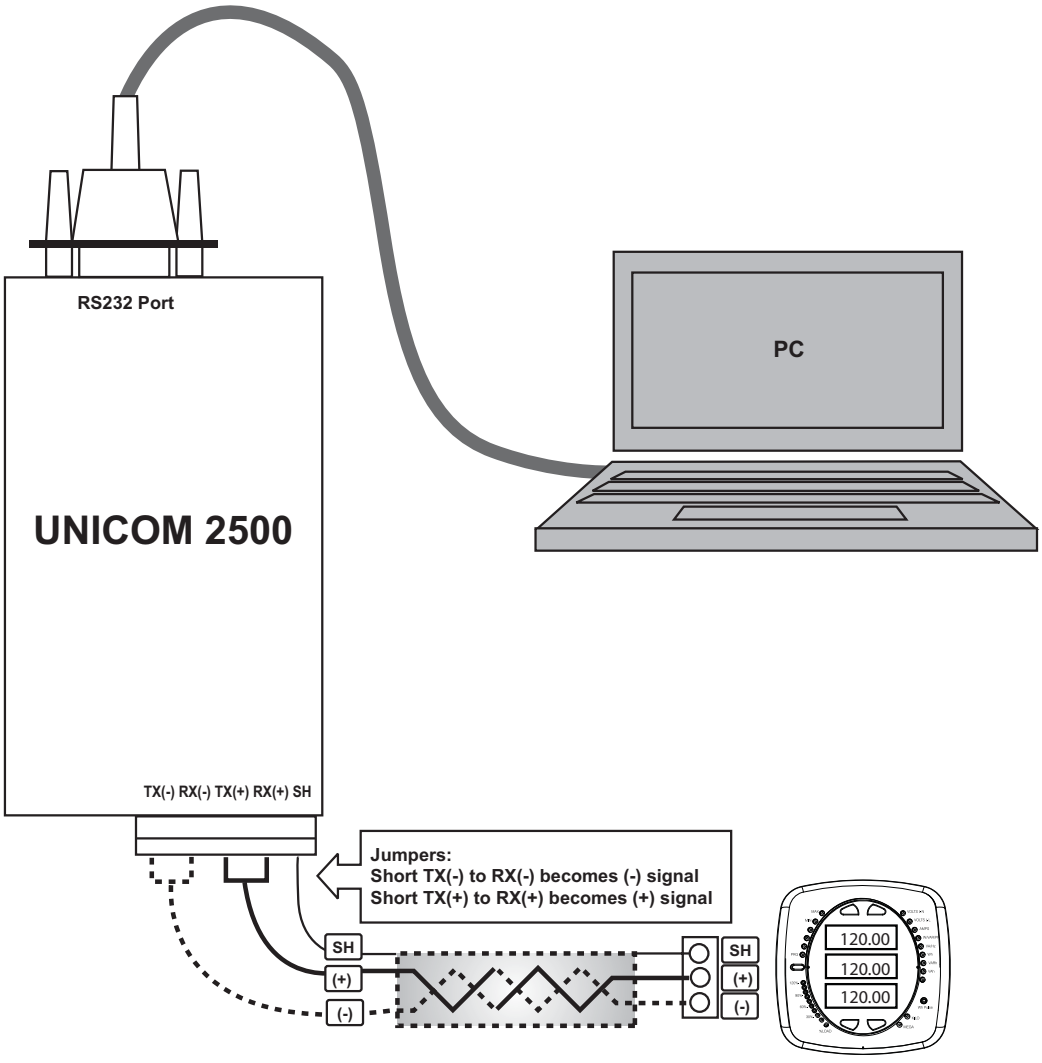
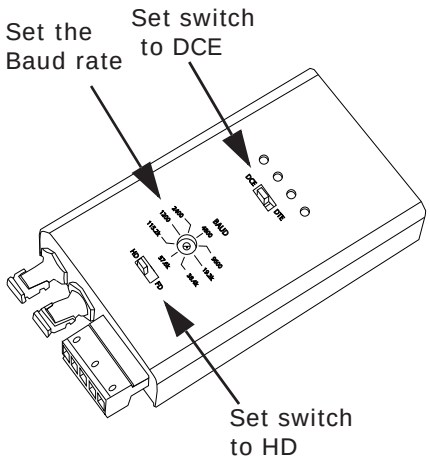


Figure 5.7: Unicom 2500 with Connections

The Unicom 2500 can be configured for either 4-wire or 2-wire RS485 connections. Since the Shark® 100/50 uses a 2-wire connection, you need to add jumper wires to convert the Unicom 2500 to the 2-wire configuration. As shown in Figure 5.7, you connect the “RX -” and “TX -” terminals with a jumper wire to make the “-” terminal, and connect the “RX +” and “TX +” terminals with a jumper wire to make the “+” terminal. See the figure on the right for the Unicom 2500’s settings. The Unicom’s Baud rate must match the Baud rate of the meter’s RS485 port: you set the Baud rate by turning the screw to point at the rate you want.



Baud Rate: 9600

Address: 001

Protocol: Modbus RTU

5.2: Configuring the Shark® 100 - INP10 Ethernet Connection

The INP10 option is the Ethernet option for the standard Shark® 100 meter. It allows the Shark® 100 to communicate on a Local Area Network (LAN). The meter is easily configured through a host PC using a Telnet connection. Once configured, you can access the meter directly through any computer on your LAN.

NOTE: If you are using Windows 7 you need to enable Telnet before using it. See the instructions on page 5-11.

This section outlines the procedures for setting up the parameters for Ethernet communication:

- Host PC setup - Section 5.3.1
- Shark® meter setup - Section 5.3.2

5.2.1: Setting up the Host PC to Communicate with the Shark® 100 - INP10 meter

Consult with your Network Administrator before performing these steps because some of the functions may be restricted to Administrator privileges.

The Host PC could have multiple Ethernet Adapters (Network Cards) installed. Identify and configure the one that will be used for accessing the Shark® 100 - INP10 meter.

The PC's Ethernet Adapter must be set up for point-to-point communication when configuring the Shark® 100 meter's INP10 option. The Factory Default IP parameters programmed in the INP10 card are:

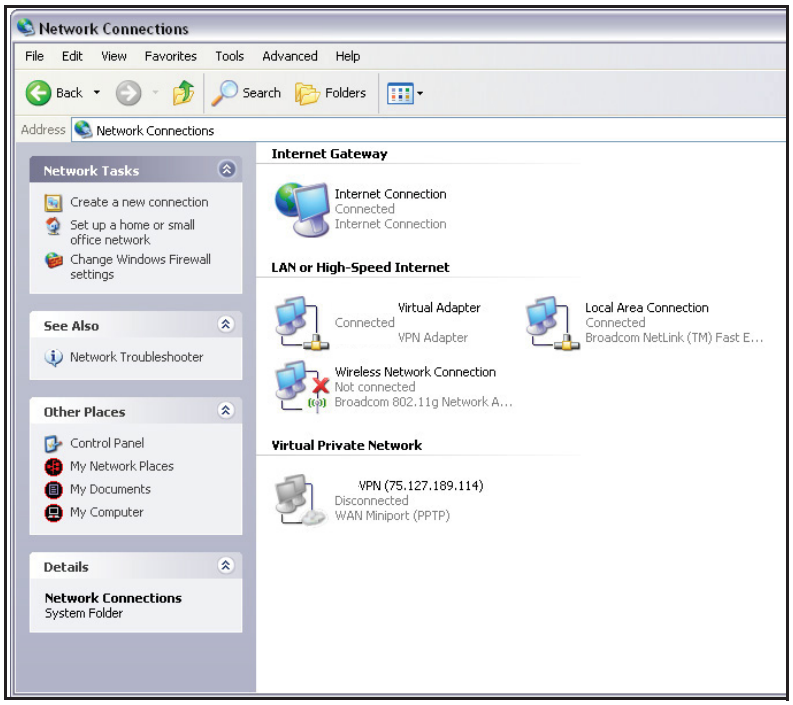
IP Address: 10.0.0.1
Subnet Mask: 255.255.255.0
See Section 5.3.2. for additional parameters.

5.2.1.1: Configuring the Host PC's Ethernet Adapter through Windows©

The following example shows the PC configuration settings that allow you to access the Shark® 100 - INP10 meter configured with default parameters. Use the same procedure when the settings differ from the default settings.

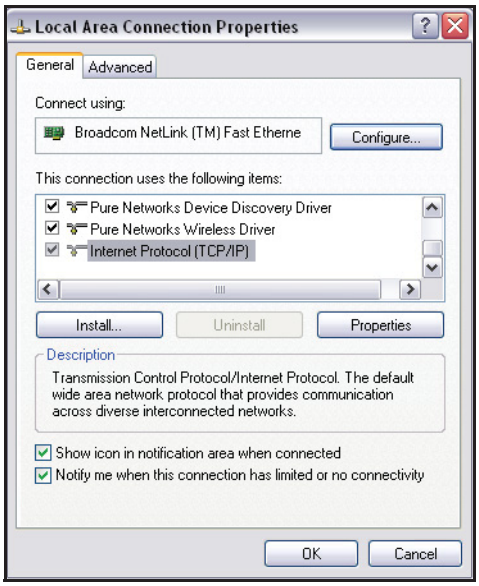
1. From the Start Menu, select **Control Panel>Network Connections**. You will see the window shown on the right.

2. Right click on the Local Area Network Connection you will use to connect to the Shark® 100 meter and select **Properties** from the drop-down menu.



3. You will see the window shown on the right.

   Select Internet Protocol [TCP/IP] and click the **Properties** button.

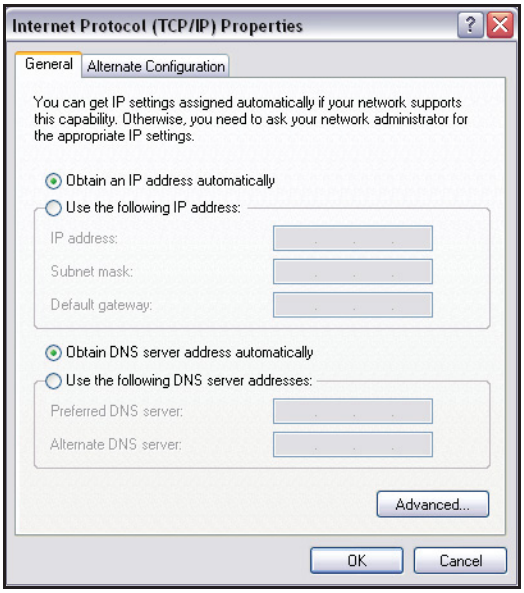


4. You will see the window shown on the right. Click the **Use the Following IP Address** radio button and enter these parameters:

   IP Address: 10.0.0.2

   Subnet Mask: 255.255.255.0

5. Click the **OK** button. You have completed the setup procedure.


Internet Protocol (TCP/IP) Properties
General
Alternate Configuration
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
Subnet mask:
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Advanced...
OK
Cancel

5.2.2: Setting up the Shark® 100 - INP10 Meter for Ethernet Communication

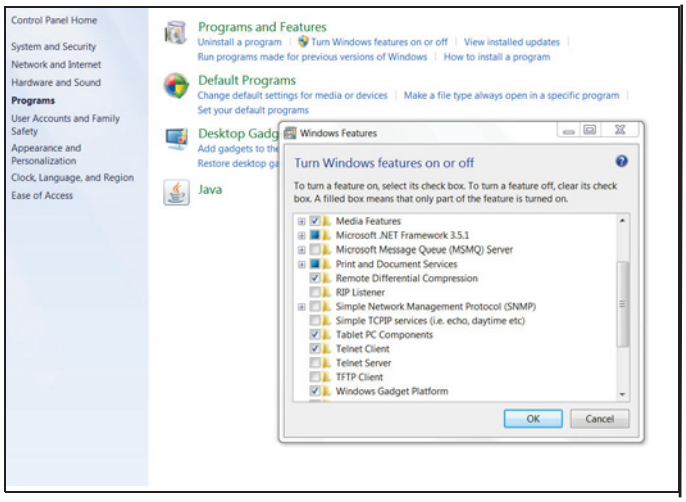
Below are the Factory Default settings for the Shark® 100 - INP10 meter's Ethernet card. These are programmed into the meter before it is shipped out from the factory. Parameters in group 1 may need to be altered to satisfy the local Ethernet configuration requirements. **Other parameters (2, 3, 4) should not be altered.**

1) Network/IP Settings:
IP Address 10.0.0.1
Default Gateway ..... --- not set ---
Netmask ..... …255.255.255.0
2) Serial & Mode Settings:
Protocol ..... Modbus/RTU,Slave(s) attached
Serial Interface 57600,8,N,1,RS232
3) Modem/Configurable Pin Settings:
CP1……..Not Used
CP2……..Not Used
CP3……..Not Used
4) Advanced Modbus Protocol settings:
Slave Addr/Unit Id Source .. Modbus/TCP header
Modbus Serial Broadcasts ... Disabled (Id=0 auto-mapped to 1)
MB/TCP Exception Codes ..... Yes (return 00AH and 00BH)
Char, Message Timeout 00050msec, 05000msec

The Ethernet card in the Shark® 100 meter can be locally or remotely configured using a Telnet connection over the network.

NOTE: If you are using Windows 7, you need to enable Telnet before using it:

1. Open the Control Panel.
2. Select Programs.
3. Select Turn Windows features on or off.
4. Check the box for Telnet Client.
5. Click OK. The Telnet client is now available.


Control Panel Home
System and Security
Network and Internet
Hardware and Sound
Programs
User Accounts and Family Safety
Appearance and Personalization
Clock, Language, and Region
Ease of Access
Programs and Features
Uninstall a program
Turn Windows features on or off
View installed updates
Run programs made for previous versions of Windows
How to install a program
Default Programs
Change default settings for media or devices
Make a file type always open in a specific program
Set your default programs
Java
Windows Features
Turn Windows features on or off
To turn a feature on, select its check box. To turn a feature off, clear its check box. A filled box means that only part of the feature is turned on.
Media Features
Microsoft .NET Framework 3.5.1
Microsoft Message Queue (MSMQ) Server
Print and Document Services
Remote Differential Compression
RIP Listener
Simple Network Management Protocol (SNMP)
Simple TCPIP services (i.e. echo, daytime etc)
Tablet PC Components
Telnet Client
Telnet Server
TFTP Client
Windows Gadget Platform
OK
Cancel

The configuration parameters can be changed at any time and are retained when the meter is not powered up. After the configuration has been changed and saved, the Ethernet card performs a reset.

Only one person at a time should be logged into the network port used for setting up the meter. This eliminates the possibility of several people trying to configure the Ethernet interface simultaneously.

It is possible to reset the Ethernet card to its default values. Follow the procedure in Section 5.2.2.2.

5.2.2.1: Configuring the Shark® 100 - INP10 Meter's Ethernet Connection on the Host Computer

Establish a Telnet connection on port 9999. Follow these steps:

1. From the Windows Start menu, click **Run** and type 'cmd'.

2. Click the **OK** button to bring up the Windows' Command Prompt window.

3. In the Command Prompt window, type: “telnet 10.0.0.1 9999" and press the **Enter** key.
   NOTE: Make sure there is a space between the IP address and 9999.
   When the Telnet connection is established you will see a message similar to the example shown below.

```
Serial Number 5415404  MAC Address  00:20:4A:54:3C:2C
Software Version V01.2 (000719)
Press Enter to go into Setup Mode
```

4. To proceed to Setup Mode press Enter again. You will see a screen similar to the one shown on the next page.

```
1) Network/IP Settings:
    IP Address .....….. 10.0.0.1
    Default Gateway .....--- not set ---
    Netmask .....…255.255.255.0
2) Serial & Mode Settings:
    Protocol ..... Modbus/RTU,Slave(s) attached
    Serial Interface ..... 57600,8,N,1,RS232,CH1
3) Modem/Configurable Pin Settings:
    CP1……..Not Used
    CP2……..Not Used
    CP3……..Not Used
4) Advanced Modbus Protocol settings:
    Slave Addr/Unit Id Source .. Modbus/TCP header
    Modbus Serial Broadcasts ... Disabled (Id=0 auto-mapped to 1)
    MB/TCP Exception Codes ..... Yes (return 00AH and 00BH)
    Char, Message Timeout ..... 00050msec, 05000msec

D)efault settings, S)ave, Q)uit without save
Select Command or parameter set (1..4) to change:
```

5. Change ONLY the parameters in group 1. To do so:

   a. Type number "**1**."

   b. Once group 1 is selected, the individual parameters display for editing. Either:

      • Enter a new parameter if a change is required.

      • Press **Enter** to proceed to the next parameter without changing the current setting.

   IMPORTANT! Settings 2, 3, and 4 must have the default values shown above.

   (**Example**: Setting device with static IP Address.)

   IP Address <010> 192.<000> 168.<000> .<000> .<001>

   Set Gateway IP Address <N>? Y

   Gateway IP Address: <192> .<168> .<000> .<001>

   Set Netmask <N for default> <Y>? Y

6. Continue setting up parameters as needed. After you finish your modifications, make sure to press the "**S**" key on the keyboard. This saves the new values and causes a Reset in the Ethernet card.
   CAUTION! DO NOT PRESS 'D' as it will overwrite any changes and save the default values.

5.2.2.2: Resetting the Ethernet Card (INP10)

If the IP Address of the Ethernet card is unknown, you can restore the factory default settings by pressing the Reset button on the card. The INP10 card's Reset button is accessed from the back of the Shark® 100 - INP10 meter. See the figure below.

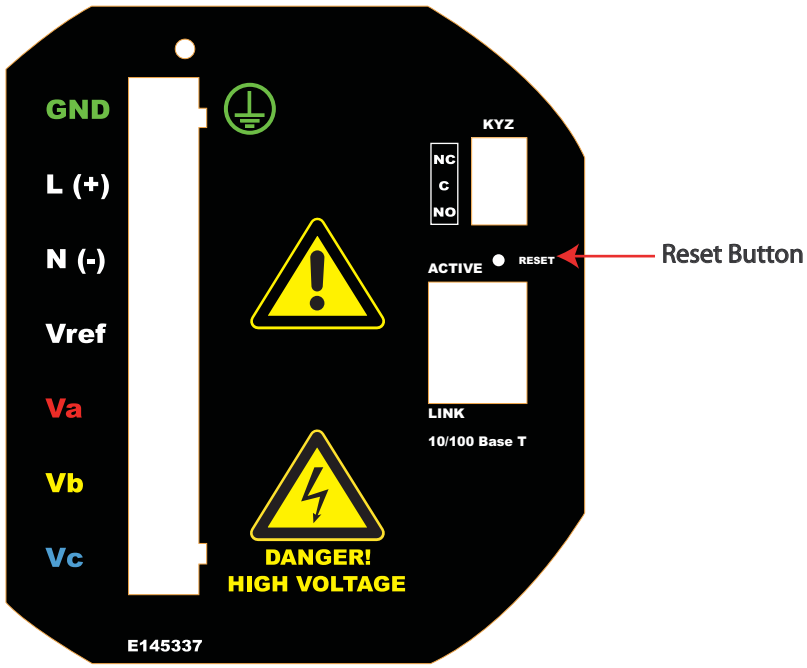


Figure 5.8: Backplate of Shark® 100 - INP10 meter, showing Reset button

Using an implement such as a ballpoint pen tip, press and hold the Reset button for 30 seconds. The INP10 card will be reset to the default settings shown in Section 5.2.2.

5.3: Shark® 50B/100B Meter Ethernet Configuration

See Chapter 7 for detailed instructions on configuring the Shark® 100B meter's Ethernet communication and Chapter 8 for detailed instructions on configuring the Shark® 50B meter's Ethernet communication.

6: Using the Shark® 100/50 Meter

If you have a Shark® 100/100B/50/50B meter, you can use the Elements and Buttons on the meter's face to view meter readings, reset and/or configure the meter, and perform related functions. Since the Shark® 100T/100BT transducer does not have a faceplate, you configure the transducer through communication (see Chapter 5 for an explanation of meter/transducer communication options) using Communicator EXT™ 4.0 software. You can also use this software to configure the Shark® 100/100B/50/50B meters through communication.

The following sections explain meter programming, first by using the faceplate and then with Communicator EXT™ software.

6.1: Programming the Shark® 100/100B/50/50B Meter Using the Faceplate

The following sections explain meter programming using the buttons and elements on the meter's faceplate.

6.1.1: Understanding Meter Face Elements

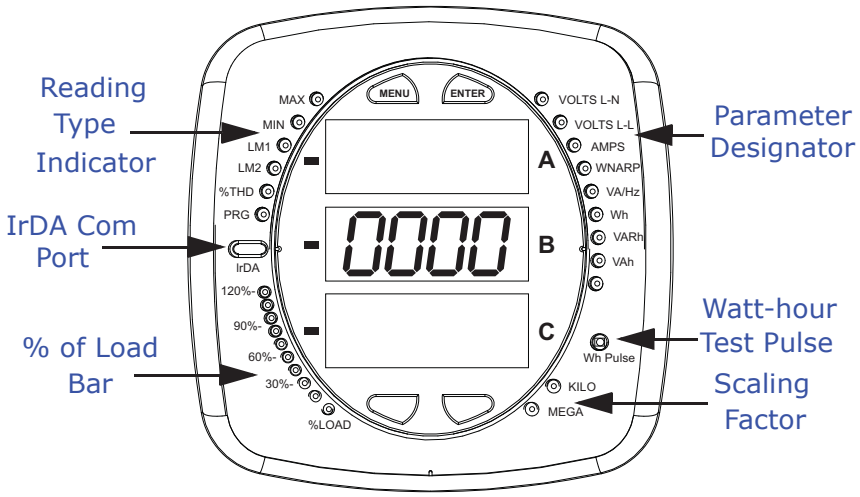


Figure 6.1: Faceplate with Elements

The meter face features the following elements:

- Reading Type Indicator: e.g., Max (The Shark® 50/50B meter has Max and Min only.)

- Parameter Designator: e.g., volts L-N
- Watt-Hour Test Pulse: Energy pulse output to test accuracy
- Scaling Factor: Kilo or Mega multiplier of displayed readings
- % of Load Bar: Graphic display of amps as % of the load (Refer to Section 6.3 for additional information.)
- IrDA Communication Port: Com 1 port for wireless communication (The Shark® 50/50B meter does not have the IrDA port.)

6.1.2: Understanding Meter Face Buttons

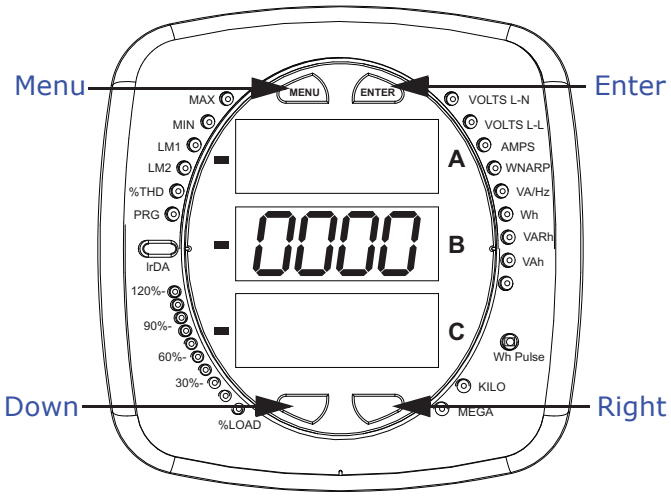


Figure 6.2: Faceplate with Buttons

The meter face has **Menu**, **Enter**, **Down** and **Right** buttons, which let you perform the following functions:

- View Meter Information
- Enter Display Modes
- Configure Parameters (may be Password Protected)
- Perform Resets (may be Password Protected)

- Perform LED Checks
- Change Settings
- View Parameter Values
- Scroll Parameter Values
- View Limit States

6.2: Using the Front Panel

You can access four modes using the Shark® 100/100B/50/50B meter's front panel buttons:

- Operating mode (Default)
- Reset mode
- Configuration mode
- Information mode - Information mode displays a sequence of screens that show model information, such as frequency, amps, V-Switch™ key, etc.

Use the **Menu**, **Enter**, **Down** and **Right** buttons to navigate through each mode and its related screens.

NOTES: See Appendix A for the complete display mode Navigation maps.

6.2.1: Understanding Startup and Default Displays

Upon Power Up, the meter displays a sequence of screens:

- Lamp Test screen where all LEDs are lit
- Lamp Test screen where all digits are lit
- Firmware screen showing build number
- Error screen (if an error exists)

After startup, if auto-scrolling is enabled, the Shark® 100/100B/50/50B meter scrolls the parameter readings on the right side of the front panel. The Kilo or Mega LED

lights, showing the scale for the Wh, VARh and VAh readings. Figure 6.3 shows an example of a Wh reading.

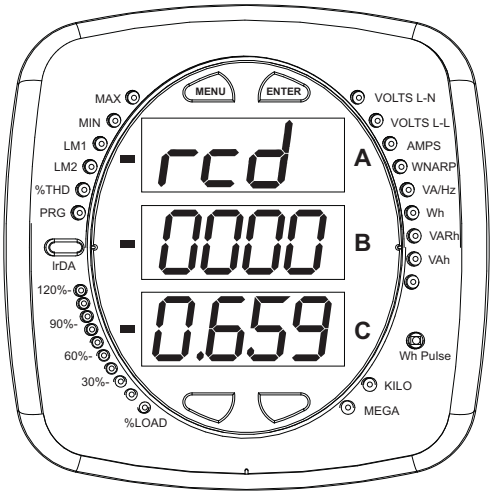


Figure 6.3: Display Showing Watt-hr Reading

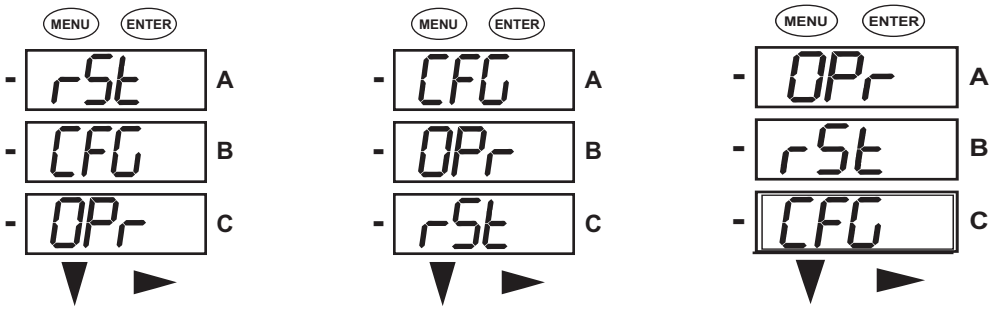
The meter continues to provide scrolling readings until one of the buttons on the front panel is pressed, causing the meter to enter one of the other modes.

6.2.2: Using the Main Menu

1. Press the **Menu** button. The Main Menu screen appears.

- The Reset mode (rSt) appears in the A window. Use the Down button to scroll, causing the Configuration (CFG), Operating (OPr), and Information (InFo) modes to move to the A window.

- The mode that is currently flashing in the A window is the "Active" mode, which means it is the mode that can be configured.

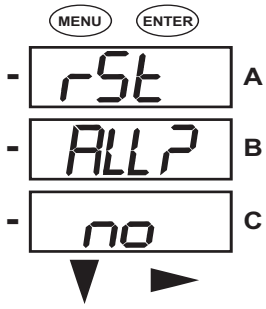


For example: Press Down Once - CFG moves to A window. Press Down Once - OPr moves to A window.

2. Press the **Enter** button from the Main Menu to view the Parameters screen for the mode that is currently active.

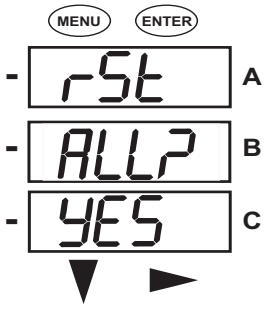
6.2.3: Using Reset Mode

1. Press the Enter button while rSt is in the A window. The "rSt (Reset) ALL? no" screen appears.



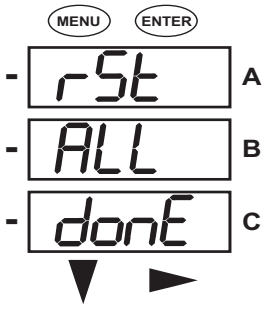
   - If you press the **Enter** button again, the Main Menu appears, with the next mode in the A window. (The **Down** button does not affect this screen.)

   - If you press the **Right** button, the "rSt ALL? YES" screen appears. Press **Enter** to perform a reset.
     CAUTION! All Max and Min values will be reset.



NOTE: If Password protection is enabled for reset, you must enter the four digit password before you can reset the meter (see Chapter 6 for information on Password protection). To enter a password, follow the instructions in Section 6.2.4.

2. Once you have performed a reset, the screen displays "rSt ALL donE" and then resumes auto-scrolling parameters.



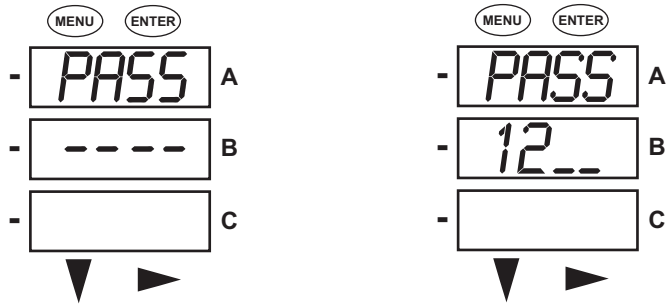
6.2.4: Entering a Password

If Password protection has been enabled in the software for reset and/or configuration (see Section 6.5.3 for information), a screen appears requesting a password when you try to reset the meter and/or configure settings through the front panel.

- PASS appears in the A window and 4 dashes appear in the B window. The leftmost dash is flashing.

1. Press the **Down** button to scroll numbers from 0 to 9 for the flashing dash. When the correct number appears for that dash, use the **Right** button to move to the next dash.

Example: The left screen, below, shows four dashes. The right screen shows the display after the first two digits of the password have been entered.



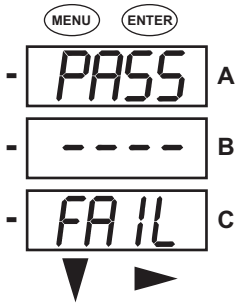
2. When all 4 digits of the password have been selected, press the **Enter** button.

- If you are in Reset Mode and you enter the correct password, "rSt ALL donE" appears and the screen resumes auto-scrolling parameters.

- If you are in Configuration Mode and you enter the correct password, the display returns to the screen that required a password.

- If you enter an incorrect password, "PASS ---- FAIL" appears and:

  - The previous screen is re-displayed, if you are in Reset Mode.
  - The previous Operating mode screen is re-displayed, if you are in Configuration mode.



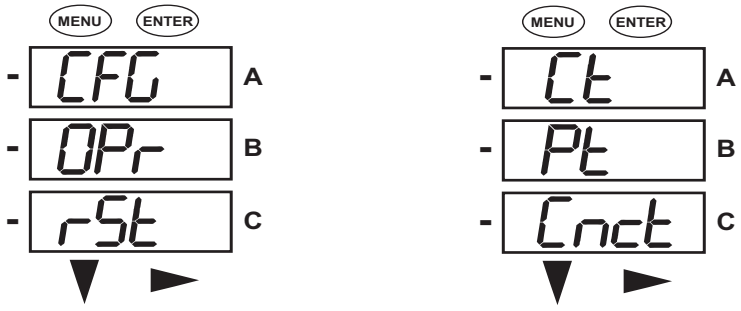
6.2.5: Using Configuration Mode

Configuration mode follows Reset: Energy on the Main Menu.

To access Configuration mode

1. Press the **Menu** button while the meter is auto-scrolling parameters.
2. Press the **Down** button until the Configuration Mode option (CFG) is in the A window.
3. Press the **Enter** button. The Configuration Parameters screen appears.
4. Press the **Down** button to scroll through the configuration parameters: Scroll (SCrL), CT, PT, Connection (Cnct) and Port. The parameter currently 'Active," i.e., configurable, flashes in the A window.
5. Press the **Enter** button to access the Setting screen for the currently active parameter.

NOTE: You can use the **Enter** button to scroll through all of the Configuration parameters and their Setting screens, in order.



Press **Enter** when CFG is in A window - Parameter screen appears -

Press **Down**- Press **Enter** when

Parameter you want is in A window

6. The parameter screen appears, showing the current settings. To change the settings:
   - Use either the **Down** button or the **Right** button to select an option.

- To enter a number value, use the **Down** button to select the number value for a digit and the **Right** button to move to the next digit.

NOTE: When you try to change the current setting and Password protection is enabled for the meter, the Password screen appears. See Section 6.2.4 for instructions on entering a password.

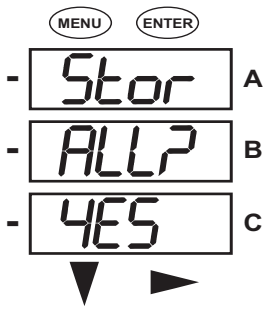
7. Once you have entered the new setting, press the **Menu** button twice.

8. The Store ALL YES screen appears. You can either:

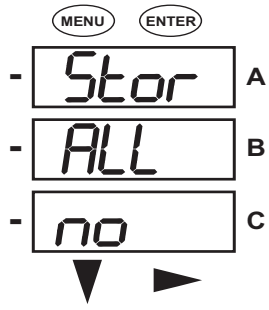
   - Press the **Enter** button to save the new setting.

   - Press the **Right** button to access the Store ALL no screen; then press the **Enter** button to cancel the Save.

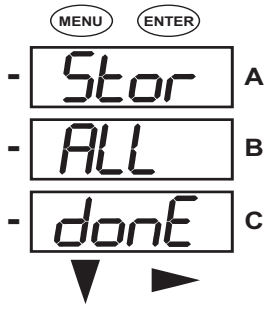
9. If you have saved the settings, the Store ALL done screen appears and the meter resets.



Press the **Enter** button to save the settings. Press the **Right** button for Stor All no screen.



Press the **Enter** button to Cancel the Save.



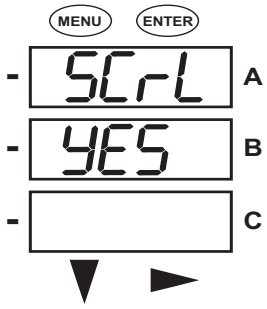
The settings have been saved.

6.2.5.1: Configuring the Scroll Feature

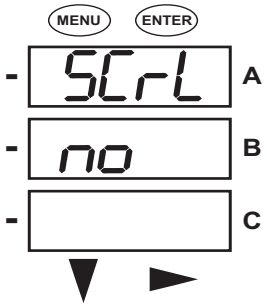
When in Auto Scroll mode, the meter performs a scrolling display, showing each parameter for 7 seconds, with a 1 second pause between parameters. The parameters that the meter displays are determined by the following conditions:

- They have been selected through software (refer to the *Communicator EXT™ 4.0 and MeterManager EXT Software User Manual* for instructions).
- They are enabled by the installed V-Switch™ key. Refer to Section 2.1.3 for information on V-Switch™ keys.

To enable or disable Auto-scrolling:



1. Press the **Enter** button when SCrl is in the A window. The Scroll YES screen appears.
2. Press either the **Right** or **Down** button if you want to access the Scroll no screen. To return to the Scroll YES screen, press either button.



3. Press the **Enter** button on either the Scroll YES screen (to enable auto-scrolling) or the Scroll no screen (to disable auto-scrolling).
4. The CT- n screen appears (this is the next Configuration mode parameter).

NOTES:

- To exit the screen without changing scrolling options, press the **Menu** button.
- To return to the Main Menu screen, press the **Menu** button twice.
- To return to the scrolling (or non-scrolling) parameters display, press the **Menu** button three times.

6.2.5.2: Configuring CT Setting

The CT Setting has three parts: Ct-n (numerator), Ct-d (denominator), and Ct-S (scaling).

1. Press the **Enter** button when Ct is in the A window. The Ct-n screen appears. You can either:

   - Change the value for the CT numerator.
   - Access one of the other CT screens by pressing the **Enter** button: press **Enter** once to access the Ct-d screen, twice to access the Ct-S screen.

     NOTE: The Ct-d screen is preset to a 5 amp or 1 amp value at the factory and cannot be changed.

   a. To change the value for the CT numerator:

      From the Ct-n screen:

      - Use the Down button to select the number value for a digit.
      - Use the Right button to move to the next digit.

   b. To change the value for CT scaling

      From the Ct-S screen:

      Use the **Right** button or the **Down** button to choose the scaling you want. The Ct-S setting can be 1, 10, or 100.

NOTE: If you are prompted to enter a password, refer to Section 6.2.4 for instructions on doing so.

2. When the new setting is entered, press the **Menu** button twice.

3. The Store ALL YES screen appears. Press **Enter** to save the new CT setting.

Example CT Settings:

200/5 amps: Set the Ct-n value for 200 and the Ct-S value for 1.

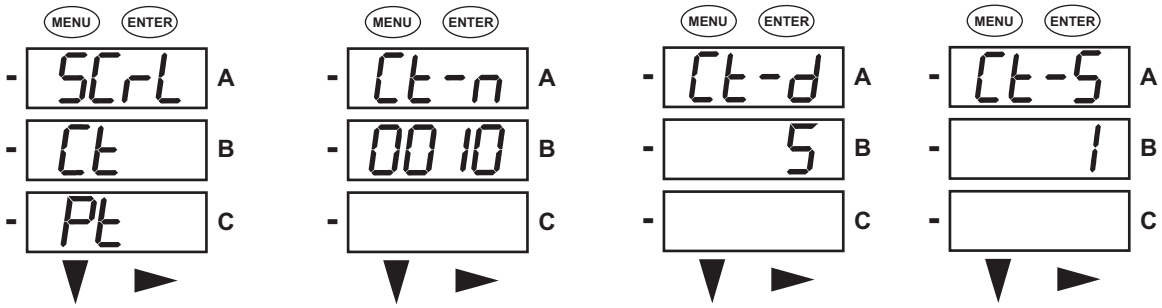
800/5 amps: Set the Ct-n value for 800 and the Ct-S value for 1.

2,000/5 amps: Set the Ct-n value for 2000 and the Ct-S value for 1.

10,000/5 amps: Set the Ct-n value for 1000 and the Ct-S value for 10.

NOTES:

- The value for amps is a product of the Ct-n value and the Ct-S value.
- Ct-n and Ct-S are dictated by primary current; Ct-d is secondary current.



Press **Enter** | Use buttons to set Ct-n | Ct-d cannot be changed | Use buttons to select scaling

6.2.5.3: Configuring PT Setting

The PT Setting has three parts: Pt-n (numerator), Pt-d (denominator), and Pt-S (scaling).

1. Press the **Enter** button when Pt is in the A window. The PT-n screen appears. You can either:
   - Change the value for the PT numerator.
   - Access one of the other PT screens by pressing the **Enter** button: press **Enter** once to access the Pt-d screen, twice to access the Pt-S screen.

   a. To change the value for the PT numerator or denominator:

   From the Pt-n or Pt-d screen:

   - Use the **Down** button to select the number value for a digit.
   - Use the **Right** button to move to the next digit.

b. To change the value for the PT scaling:

From the Pt-S screen:

Use the **Right** button or the **Down** button to choose the scaling you want. The Pt-S setting can be 1, 10, 100, or 1000.

NOTE: If you are prompted to enter a password, refer to Section 6.2.4 for instructions on doing so.

2. When the new setting is entered, press the **Menu** button twice.

3. The STOR ALL YES screen appears. Press **Enter** to save the new PT setting.

Example PT Settings:

277/277 volts: Pt-n value is 277, Pt-d value is 277, Pt-S value is 1.

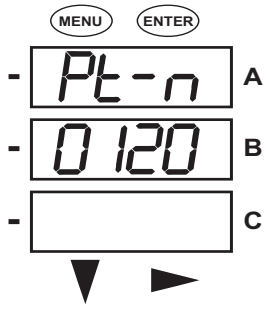
14,400/120 volts: Pt-n value is 1440, Pt-d value is 120, Pt-S value is 10.

138,000/69 volts: Pt-n value is 1380, Pt-d value is 69, Pt-S value is 100.

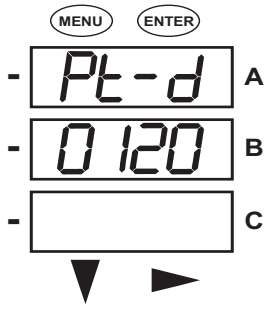
345,000/115 volts: Pt-n value is 3450, Pt-d value is 115, Pt-S value is 100.

345,000/69 volts: Pt-n value is 345, Pt-d value is 69, Pt-S value is 1000.

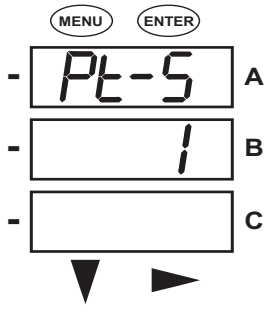
NOTE: Pt-n and Pt-S are dictated by primary Voltage; Pt-d is secondary Voltage.



Use buttons to set Pt-n



Use buttons to set Pt-d



Use buttons to select scaling

6.2.5.4: Configuring Connection Setting

1. Press the **Enter** button when Cnct is in the A window. The Cnct screen appears.

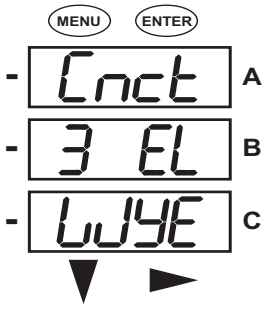
2. Press the **Right** button or **Down** button to select a configuration. The choices are:

   - 3 Element Wye (3 EL WYE)
   - 2.5 Element Wye (2.5EL WYE)
   - 2 CT Delta (2 Ct dEL)

NOTE: If you are prompted to enter a password, refer to Section 6.2.4 for instructions on doing so.

3. When you have made your selection, press the **Menu** button twice.

4. The STOR ALL YES screen appears. Press **Enter** to save the setting.



Use buttons to select configuration

6.2.5.5: Configuring Communication Port Setting

Port configuration consists of: Address (a three digit number), Baud Rate (9600; 19200; 38400; or 57600), and Protocol (DNP 3.0; Modbus RTU; or Modbus ASCII).

1. Press the **Enter** button when POrt is in the A window. The Adr (address) screen appears. You can either:

   - Enter the address.
   - Access one of the other Port screens by pressing the **Enter** button: press **Enter** once to access the bAUd screen (Baud Rate), twice to access the Prot screen (Protocol).

a. To enter the Address

From the Adr screen:

- Use the **Down** button to select the number value for a digit.
- Use the **Right** button to move to the next digit.

b. To select the Baud Rate:

From the bAUd screen:

Use the **Right** button or the **Down** button to select the setting you want.

c. To select the Protocol:

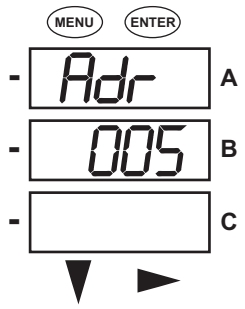
From the Prot screen:

Press the **Right** button or the **Down** button to select the setting you want.

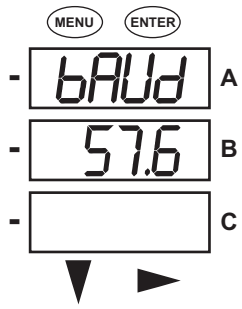
NOTE: If you are prompted to enter a password, refer to Section 6.2.4 for instructions on doing so.

2. When you have finished making your selections, press the **Menu** button twice.

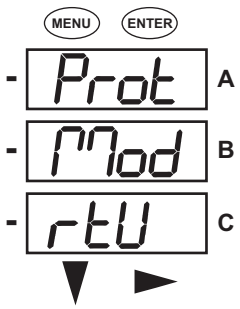
3. The STOR ALL YES screen appears. Press **Enter** to save the settings.



Use buttons to enter Address



Use buttons to select Baud Rate



Use buttons to select Protocol

6.2.6: Using Operating Mode

Operating mode is the Shark® 100/100B/50/50B meter's default mode, that is, the standard front panel display. After starting up, the meter automatically scrolls through the parameter screens, if scrolling is enabled. Each parameter is shown for 7 seconds, with a 1 second pause between parameters. Scrolling is suspended for 3 minutes after any button is pressed.

1. Press the **Down** button to scroll all the parameters in Operating mode. The currently "Active," i.e., displayed, parameter has the Indicator light next to it, on the right face of the meter.

2. Press the **Right** button to view additional readings for that parameter. The table below shows possible readings for Operating mode. Sheet 2 in Appendix A shows the Operating mode Navigation map.

NOTE: Readings or groups of readings are skipped if not applicable to the meter type or hookup, or if they are disabled in the programmable settings.

OPERATING MODE PARAMETER READINGS

POSSIBLE READINGS

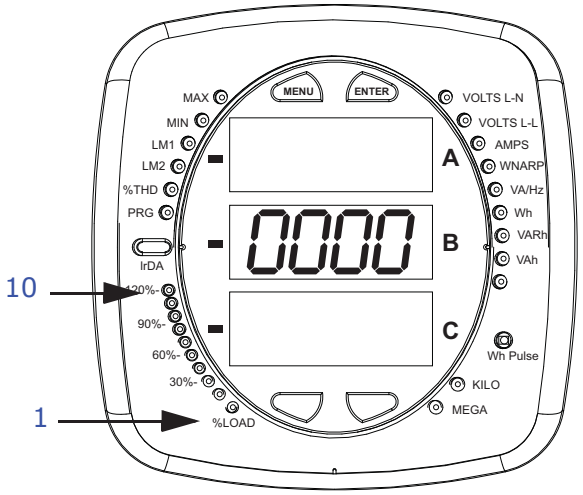
VOLTS L-N	VOLTS_LN	VOLTS_L-N_MAX	VOLTS_L-N_MIN		VOLTS_L-N_THD
VOLTS L-L	VOLTS_LL	VOLTS_LL_MAX	VOLTS_LL_MIN		
AMPS	AMPS	AMPS_-NEUTRAL	AMPS_MAX	AMPS_MIN	AMPS_THD
W/VAR/PF	W_VAR_PF	W_VAR_P-F_MAX_-POS	W_VAR_P-F_MIN_POS	W_VAR_P-F_MIN_NEG	
VA/Hz	VA_FREQ	VA_FREQ_-MAX	VA_FRE-Q_MIN		
Wh	KWH_REC	KWH_DEL	KWH_NET	KWH_TOT	
VARh	KVARH_-POS	KVAR-H_NEG	KVAR-H_NET	KVARH_-TOT	
VAh	KVAH				

6.3: Understanding the % of Load Bar

The 10-segment LED bar graph at the bottom left of the Shark® 100/100B/50/50B meter's front panel provides a graphic representation of amps. The segments light according to the load, as shown in the table below.

When the Load is over 120% of Full Load, all segments flash "On" (1.5 secs) and "Off" (0.5 secs).

Segments	Load >= % Full Load
none	no load
1	1%
1-2	15%
1-3	30%
1-4	45%
1-5	60%
1-6	72%
1-7	84%
1-8	96%
1-9	108%
1-10	120%
All Blink	>120%



6.4: Performing Watt-Hour Accuracy Testing (Verification)

To be certified for revenue metering, power providers and utility companies must verify that the billing energy meter performs to the stated accuracy. To confirm the meter's performance and calibration, power providers use field test standards to ensure that the unit's energy measurements are correct. Since the Shark® 100/ 100B/50 meter is a traceable revenue meter, it contains a utility grade test pulse that can be used to gate an accuracy standard. This is an essential feature required of all billing grade meters.

- Refer to Figure 6.5 for an example of how this process works.
- Refer to Table 6.1 for the Wh/Pulse constants for accuracy testing.

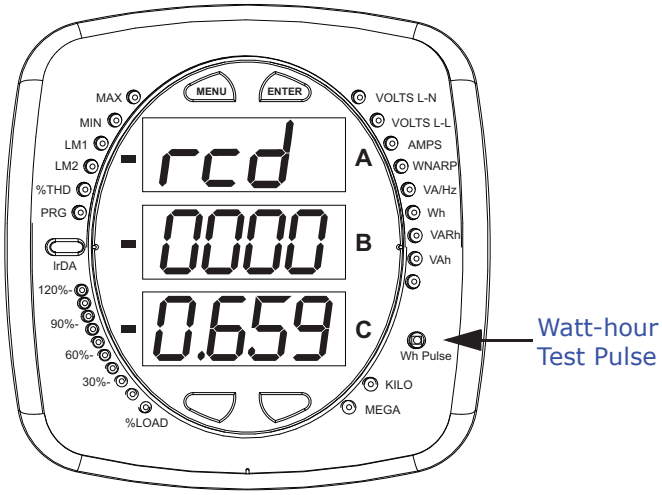


Figure 6.4: Watt-hour Test Pulse

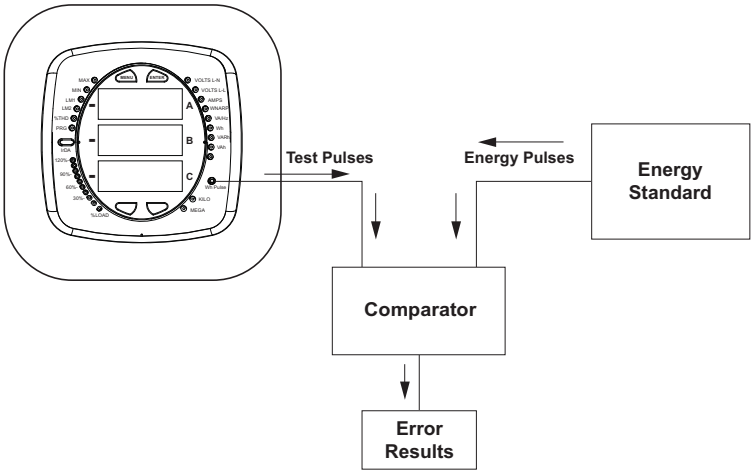


Figure 6.5: Using the Watt-hour Test Pulse

Input Voltage Level	Class 10 Models	Class 2 Models
Below 150V	0.2505759630	0.0501151926
Above 150V	1.0023038521	0.2004607704

Table 6.1: Infrared & KYZ Pulse Constants for Accuracy Testing - Kh Watt-hour per pulse

NOTES:

- Minimum pulse width is 40 milliseconds.
- Refer to Chapter 2, Section 2.2, for Wh Pulse specifications.
- The Shark® 50B meter does not have a KYZ Pulse output.

6.5: Programming the Transducer or Meter Using Software

As mentioned in the beginning of the chapter, you must program the Shark® 100T/100BT transducer using communication and software. You can also configure the Shark® 100/100B/50/50B meter this way.

6.5.1: Accessing the Transducer / Meter in Default Communication Mode (RS485 Communication)

You can connect to the Shark® transducer or meter in Default communication mode if you are using the RS485 port. This feature is useful in debugging or if you do not know the meter's programmed settings and want to find them. For 5 seconds after the Shark® transducer or meter is powered up, you can use the RS485 port with Default communication mode to poll the Name Register. You do this by connecting to the transducer/meter with the following default settings (see Section 6.5.2 on the next page):

Baud Rate: 9600

Address: 001

Protocol: Modbus RTU

The transducer/meter continues to operate with these default settings for 5 minutes. During this time, you can access the transducer/meter's Device Profile to ascertain/change device information. After 5 minutes of no activity, the transducer/meter reverts to the programmed Device Profile settings.

IMPORTANT! In Normal operating mode the initial factory communication settings are:

Baud Rate: 57600

Address: 001

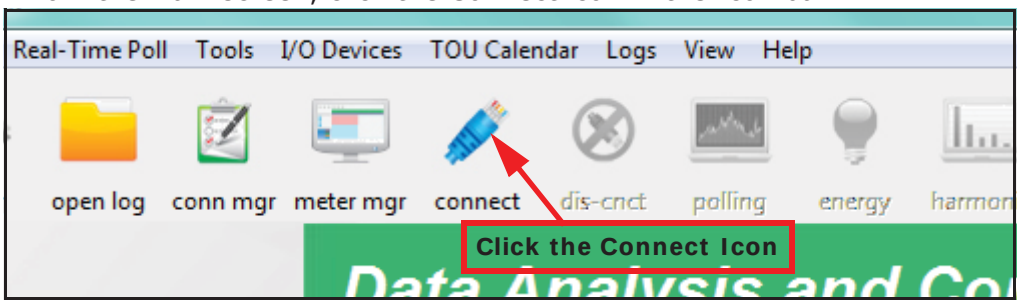
Protocol: Modbus RTU

6.5.2: Connecting to the Transducer / Meter through Communicator EXT™ Software

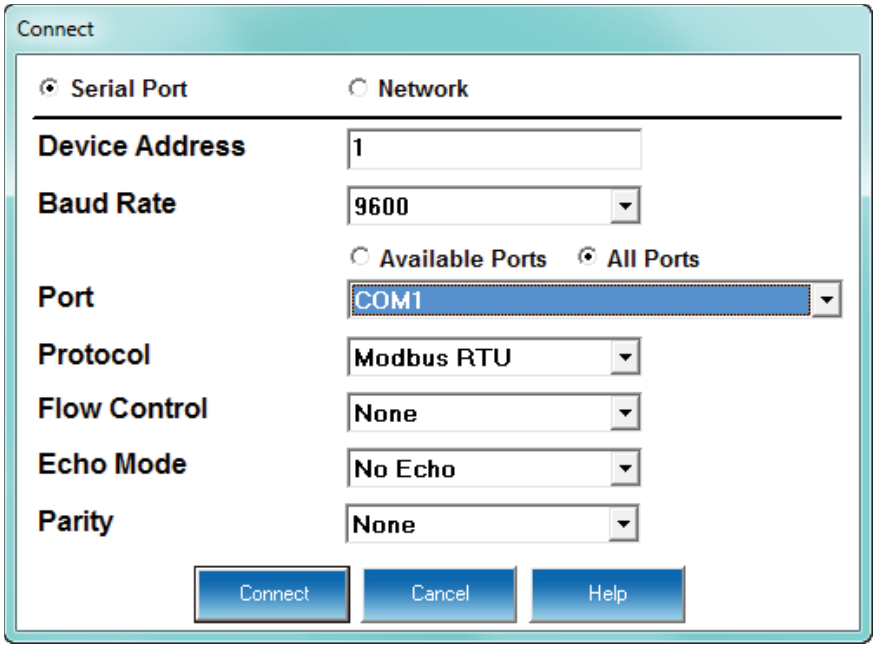
How to Connect:

1. Open Communicator EXT™ software.

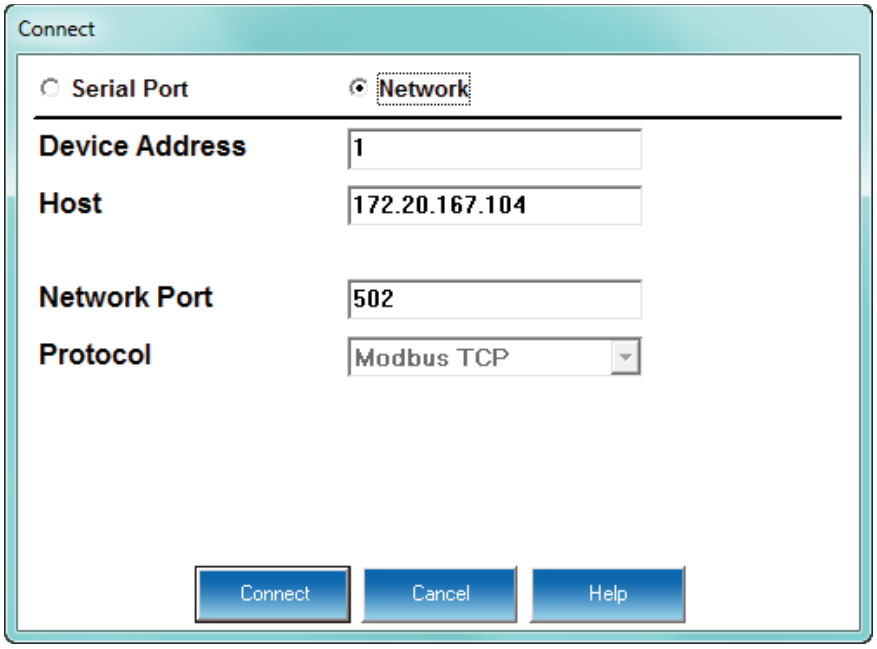
2. From the Main screen, click the Connect icon in the Icon bar.



3. The Connect screen opens. If you are connecting via RS485, make sure your settings are the same as shown here. Use the pull-down menus to make any necessary changes to the settings.



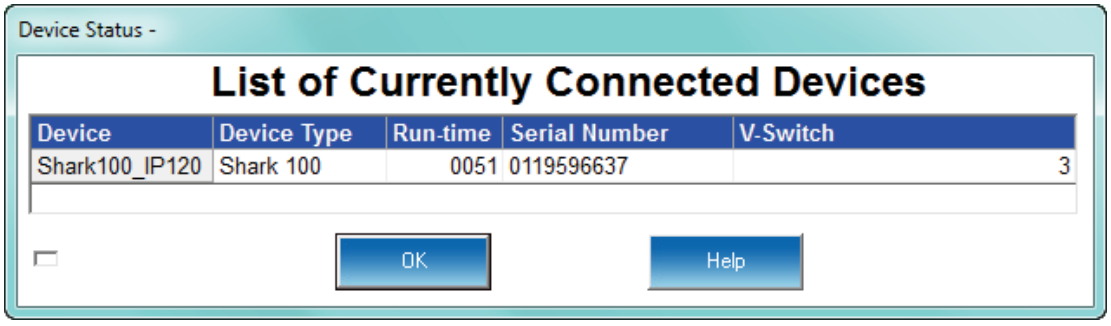
a. If you are connecting with either a Shark® 100 - INP10 meter/transducer, a Shark® 100B/100BT meter, or a Shark® 50B meter, click the Network radio button. Your screen changes to the Connect screen shown on the next page.



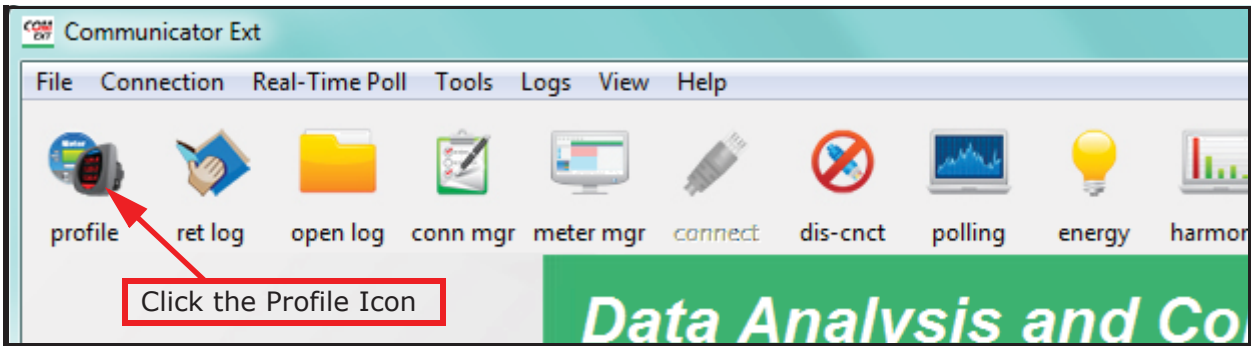
b. Enter the IP address of the INP10 card (see Chapter 5), of the Shark® 100B/100BT Ethernet card (see Chapter 7), or of the Shark® 50B Ethernet card (see Chapter 8) in the Host field.

4. Click the Connect button. If you have a problem connecting, you may have to disconnect power to the meter, then reconnect power and click the Connect button, again.

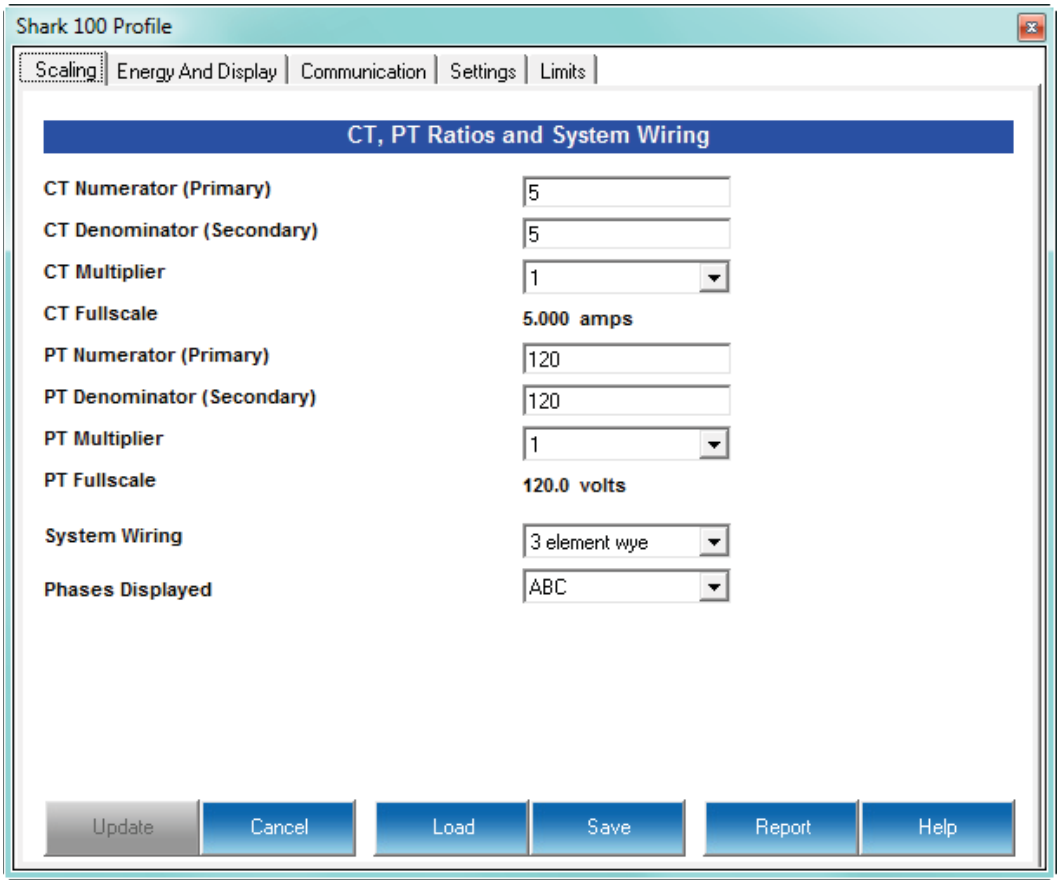
5. You will see the Device Status screen, confirming connection to your meter. Click OK.



6. Click the Profile icon in the Icon Bar.



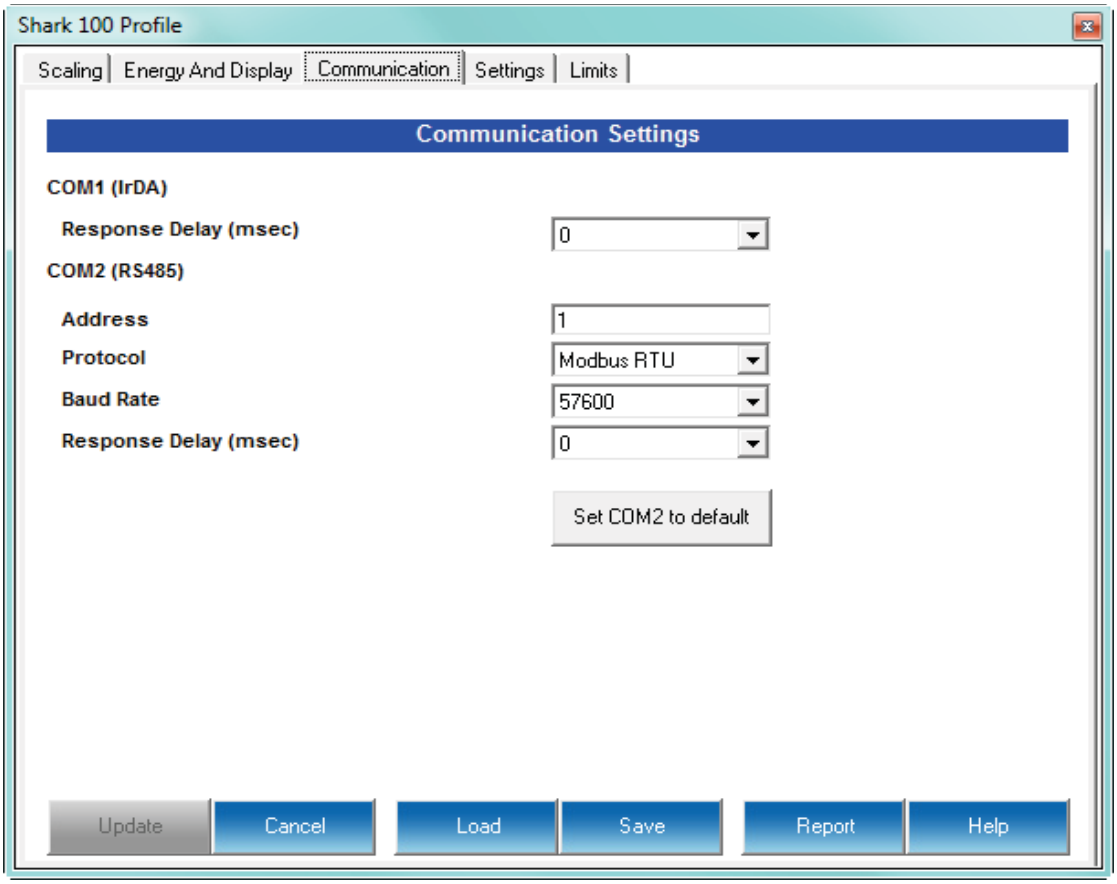
7.You will see the Device Profile screen. The tabs at the top of the screen allow you to navigate between setting screens (see below).



8. Click the Communications tab. You will see the screen shown below. Use this screen to enter communication settings for the meter's two on-board ports: the IrDA port (COM 1) and RS485 port (COM 2). Make any necessary changes to settings.

   NOTES:

   - If you have a Shark® 100 - INP10 or a Shark® 100B/100BT, you don't program the RS485 port.
   - If you have a Shark® 50/50B meter, you won't see the IrDA port settings.



9. Valid Communication Settings are as follows:

COM1	(IrDA)
Response Delay	(0-750 msec)
COM2	(RS485)
Address	(1-247)
Protocol	(Modbus RTU, Modbus ASCII or DNP)
Baud Rate	(9600 to 57600)
Response Delay	(0-750 msec)

   DNP Options for Voltage, Current, and Power - these fields allow you to choose Primary or Secondary Units for DNP, and to set custom scaling if you choose

Primary. See Chapter 9 in the *Communicator EXT™ 4.0 and MeterManager EXT Software User Manual* for more information.

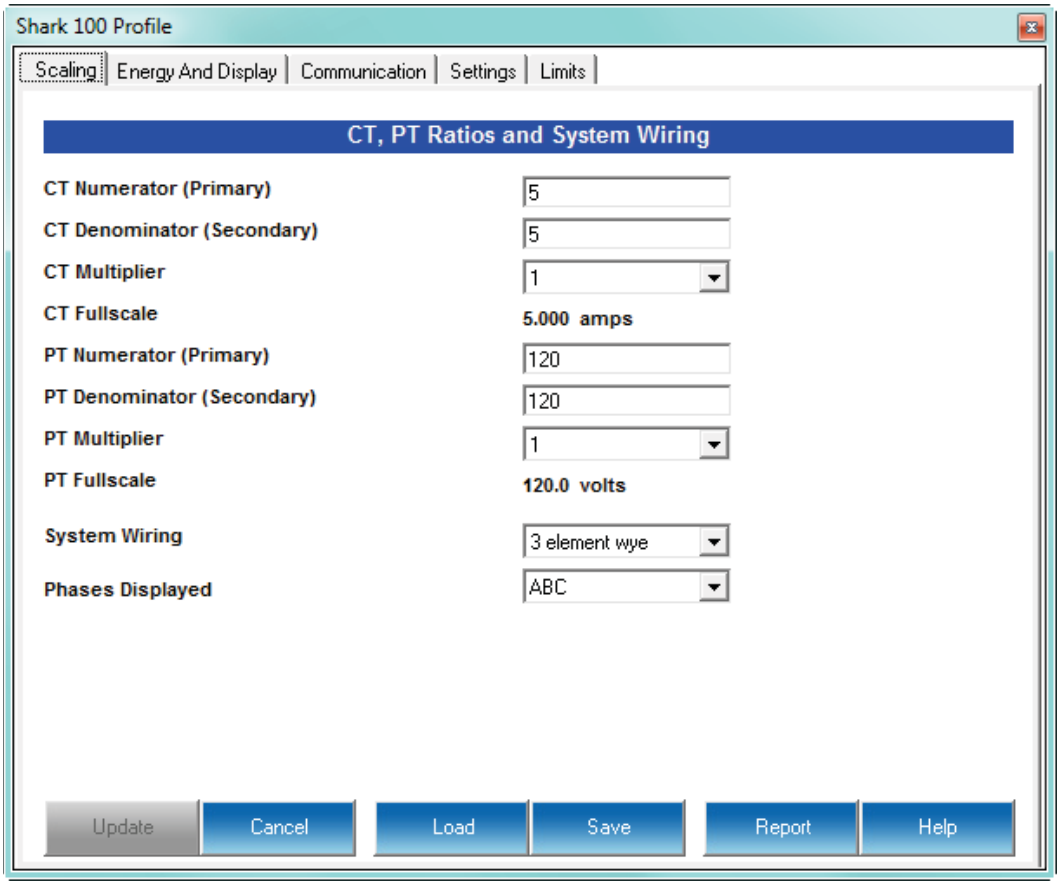
10. When changes are complete, click the Update Device button to send the new profile to the meter.

11. Click Exit to leave the Device Profile or click other tabs to change other aspects of the Device Profile (see the following section for instructions).

6.5.3: Device Profile Settings

NOTE: Only the basic Device Profile settings are explained in this manual. Refer to Chapter 9 in the *Communicator EXT™ 4.0 and MeterManager EXT Software User Manual* for detailed information concerning and instructions on configuring all settings of the meter's Device Profile. You can view the manual online by clicking Help>Contents from the Communicator EXT™ 4.0 application's Main screen.

CT, PT Ratios and System Hookup



The screen fields and acceptable entries are as follows:

CT Ratios

CT Numerator (Primary): 1 - 9999

CT Denominator (Secondary): 5 or 1 Amp

NOTE: This field is display only.

CT Multiplier: 1, 10 or 100

Current Full Scale: Calculations based on selections. Click **Recalculate** to see the result of changes.

PT Ratios

PT Numerator (Primary): 1 - 9999

PT Denominator (Secondary): 40 - 600

PT Multiplier: 1, 10, 100, or 1000

Voltage Full Scale: Calculations based on selections. Click **Recalculate** to see the result of changes.

System Wiring

3 Element Wye; 2.5 Element Wye; 2 CT Delta

Phases Displayed

A, AB, or ABC

NOTE: Voltage Full Scale = PT Numerator x PT Multiplier

Example:

A 14400/120 PT would be entered as:

PT Numerator: 1440

PT Denominator: 120

Multiplier: 10

This example would display a 14.40kV.

Example CT Settings:

200/5 amps: Set the Ct-n value for 200, Ct-Multiplier value for 1

800/5 amps: Set the Ct-n value for 800, Ct-Multiplier value for 1

2,000/5 amps: Set the Ct-n value for 2000, Ct-Multiplier value for 1

10,000/5 amps: Set the Ct-n value for 1000, Ct-Multiplier value for 10

Example PT Settings:

277/277 volts: Pt-n value is 277, Pt-d value is 277, Pt-Multiplier is 1

14,400/120 volts: Pt-n value is 1440, Pt-d value is 120, Pt-Multiplier value is 10

138,000/69 volts: Pt-n value is 1380, Pt-d value is 69, Pt-Multiplier value is 100

345,000/115 volts: Pt-n value is 3450, Pt-d value is 115, Pt-Multiplier value is 100

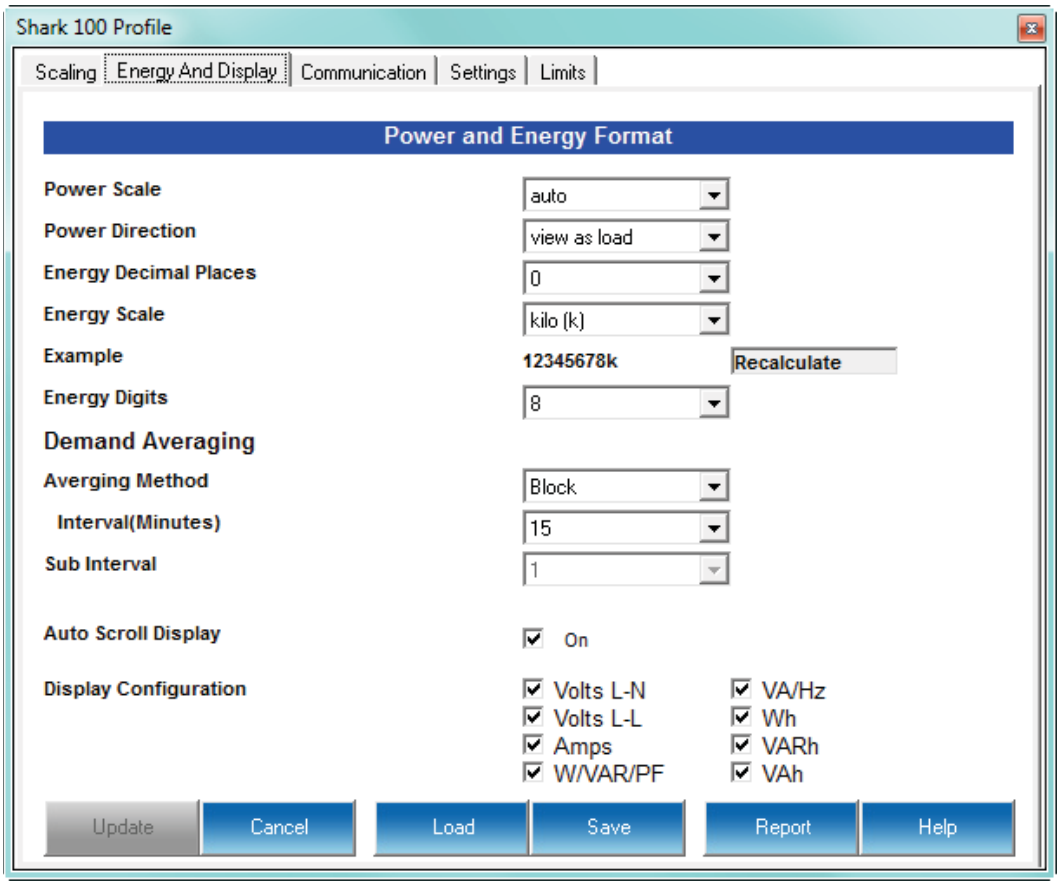
345,000/69 volts: Pt-n value is 345, Pt-d value is 69, Pt-Multiplier value is 1000

NOTE: Settings are the same for Wye and Delta configurations.

Energy and Display

The settings on this screen determine the display configuration of the meter's faceplate.

NOTE: For a Shark® 100T/100BT transducer, the Display Configuration setting does not apply as there is no display.



The screen fields and acceptable entries are as follows:

Power and Energy Format

Power Scale: Unit, kilo (k), Mega (M), or auto.

Energy Digits: 5, 6, 7, or 8

Energy Decimal Places: 0-6

Energy Scale: Unit, kilo (k), or Mega (M)

For Example: a reading for Digits: 8; Decimals: 3; Scale: k would be formatted:

00123.456k

Power Direction: View as Load or View as Generator

Demand Averaging

Averaging Method: Block or Rolling

Interval (Minutes): 5, 15, 30, or 60

Sub Interval (if Rolling is selected): 1-4

Auto Scroll

Click to set On or Off.

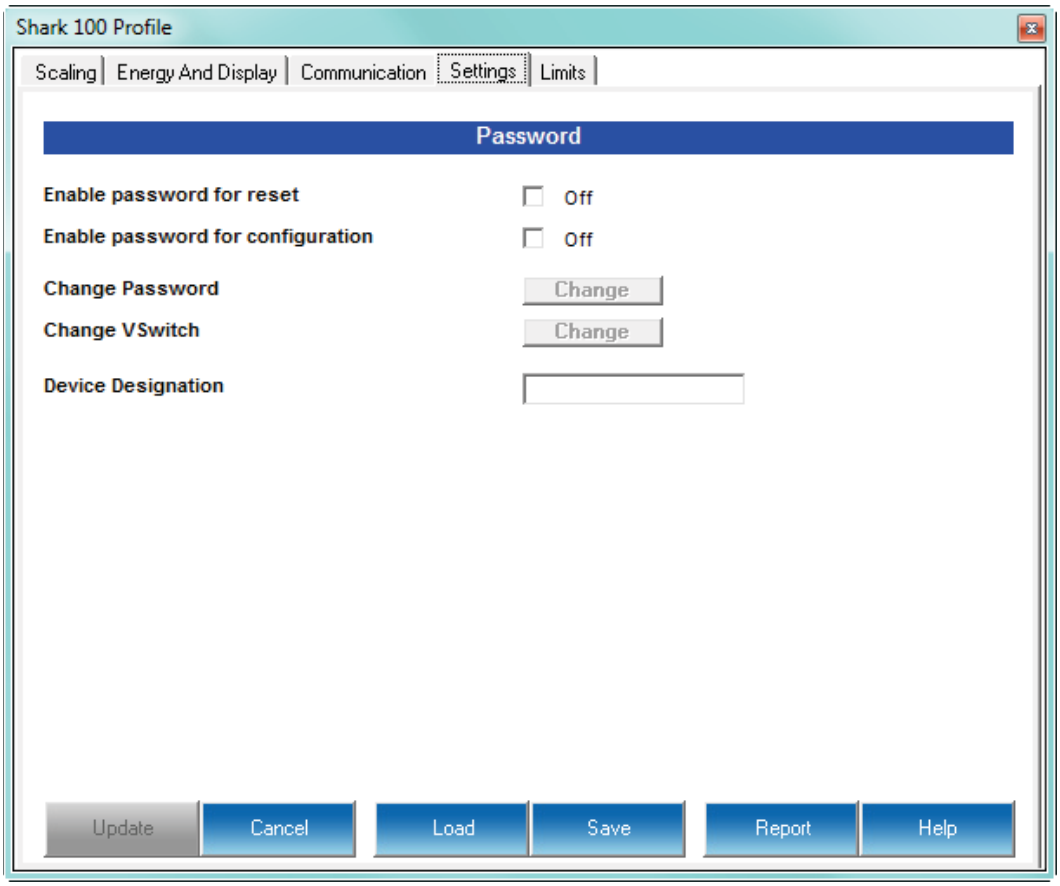
Display Configuration:

Click Values to be displayed.

NOTE: You MUST select at least ONE.

NOTE: If incorrect values are entered on this screen the following message appears: WARNING: Current, CT, PT and Energy Settings will cause invalid energy accumulator values. Change the settings until the message disappears.

Settings



The screen fields are as follows:

Password

NOTE: The meter is shipped with Password Disabled. There is NO DEFAULT PASSWORD.

Enable Password for Reset: click to enable.

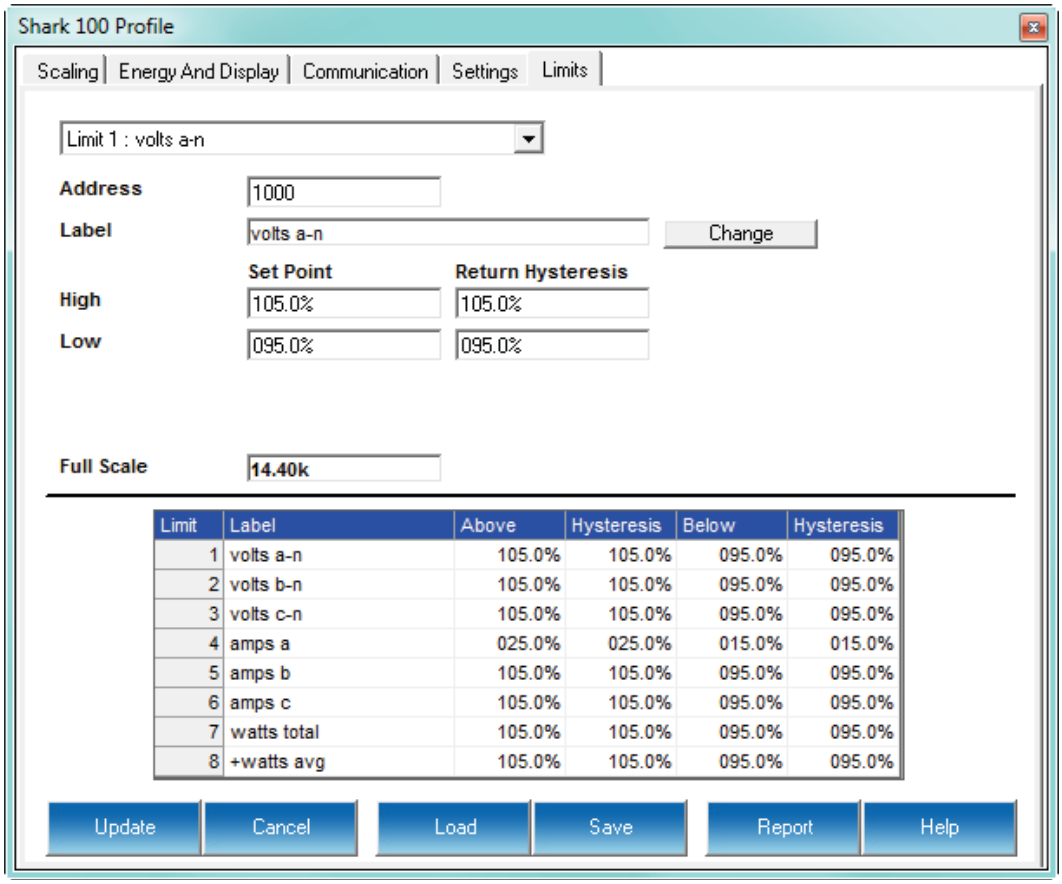
Enable Password for Configuration: click to enable.

Change Password: click to change.

Change VSwitch: click to change (see Section 2.1.3 for instructions).

Device Designation: optional user-assigned label.

Limits (Shark® 100 Meter V-Switch V4, Only)


Shark 100 Profile
Scaling
Energy And Display
Communication
Settings
Limits
Limit 1 : volts a-n
Address
1000
Label
volts a-n
Change
Set Point
Return Hysteresis
High
105.0%
105.0%
Low
095.0%
095.0%
Full Scale
14.40k
Limit | Label | Above | Hysteresis | Below | Hysteresis
1 | volts a-n | 105.0% | 105.0% | 095.0% | 095.0%
2 | volts b-n | 105.0% | 105.0% | 095.0% | 095.0%
3 | volts c-n | 105.0% | 105.0% | 095.0% | 095.0%
4 | amps a | 025.0% | 025.0% | 015.0% | 015.0%
5 | amps b | 105.0% | 105.0% | 095.0% | 095.0%
6 | amps c | 105.0% | 105.0% | 095.0% | 095.0%
7 | watts total | 105.0% | 105.0% | 095.0% | 095.0%
8 | +watts avg | 105.0% | 105.0% | 095.0% | 095.0%
Update
Cancel
Load
Save
Report
Help

Limits are transition points used to divide acceptable and unacceptable measurements. When a value goes above or below the limit, an out-of-limit condition occurs. Once they are configured, you can view the out-of-Limits (or Alarm) conditions in the Limits Log or Limits Polling screen. You can also use Limits to trigger relays. See the *Communicator EXT™ 4.0 and MeterManager EXT Software User Manual* for details.

For up to 8 Limits, set:

Address: Modbus Address (1 based)

Label: Your designation for the limit

High Set Point: % of Full Scale

Example: 100% of 120VFS = 120V; 90% of 120V FS = 108V

Return Hysteresis: Point to go back in Limit

Example: High Set Point = 110% (Out of Limit at 132V);Return Hysteresis = 105%(Stay Out until 126V)

Low Set Point: % of Full Scale

Return Hysteresis: Point to go back in Limit.

Your settings appear in the Table at the bottom of the screen

NOTES: If Return Hysteresis is > High Set Point, the Limit is Disabled.

IMPORTANT! When you have finished making changes to the Device Profile, click **Update Device** to send the new Profile settings to the meter.

NOTE: Refer to Chapter 9 of the *Communicator EXT™ 4.0 and MeterManager EXT Software User Manual* for additional instructions on configuring the Shark® 100/50 transducer/meter settings.

This page intentionally left blank.

7: Using the Shark® 100B Meter

7.1: Introduction

The Shark® 100B meter has native BACnet/IP that lets it act as a BACnet server in any BACnet application. The meter has a Web interface you can use to remotely set up the BACnet/IP and Modbus configuration and track energy readings through the Internet using any standard Web browser.

7.1.1: About BACnet

BACnet is a data communication protocol developed for Building Control applications in 1987. BACnet allows applications to process data from many different kinds of equipment and manufacturers. Originally it was used for HVAC control systems, but it has been extended to other building systems, including lighting and energy management. Today BACnet is one of the two most widely used Building Automation protocols in use. It is an ASHRAE/ANSI/ISO standard protocol.

The BACnet protocol consists of Objects that contain different kinds of information. Each Object has properties that contain data related to it. Below is the example of an Object for Total Watts:
Object_Name, PWR_ELEC
Object_Type, Analog Input
Object_Instance, AI-101018
Present_Value, watt, tot (value in watts)

BACnet operates in a client-server environment. A client machine sends a service request (message) to a server machine; once the service is performed the results are reported back to the client machine. BACnet defines 5 groups (or classes) of 35 message types. For example, one class contains messages for retrieving and manipulating the object properties described above. An example of a common service request in this class is "ReadProperty." When the server machine receives this message from a client machine, it locates the requested property of the requested object and sends the value to the client. Other classes of service requests have to do with alarms and events; file uploading/downloading; managing remote device operation; and virtual terminal functions.

BACnet/IP, which is used by the Shark® 100B meter, is a newer implementation of the BACnet standard, which allows users to perform BACnet communication through the Internet or Intranet.

For more detailed information, visit the BACnet website at www.bacnet.org.

7.2: Shark® 100B Meter's BACnet Objects

The Shark® 100B meter's BACnet/IP has 40 predefined objects of electrical measurements. No programming or mapping is necessary to use the BACnet objects. The object's names easily identify the measurements they contain.

All of the objects, with the exception of Modbus Meter and POLL_DELAY are AI (analog input) Object type. The following table lists each of the objects with their units of measurement and description.

Object Name	Unit of Measurement	Description
Modbus Meter-147222	none	(Addr. 1)
POLL_DELAY	AV-1	Polling Delay
VOLTAGE_LN-A	volt	Voltage A-N
VOLTAGE_LN-B	volt	Voltage B-N
VOLTAGE_LN-C	volt	Voltage C-N
VOLTAGE_LL-AB	volt	Voltage A-B
VOLTAGE_LL-BC	volt	Voltage B-C
VOLTAGE_LL-CA	volt	Voltage C-A
CURRENT_LN-A	amp	Current A
CURRENT_LN-B	amp	Current B
CURRENT_LN-C	amp	Current C
PWR_ELEC	watt	Total Active Power
PWR_ELEC_REACT	volt-amp-reactive	Total Reactive Power
PWR_ELEC_APPAR	volt-amp	Total Apparent Power
PWR_FACTOR	---	Total Power Factor
FREQUENCY	Hertz	Frequency
CURRENT_NG	amp	Neutral Current
ENERGY_ELEC_ACCUM_REC*	watt-hour	Active Energy Received

Object Name	Unit of Measurement	Description
ENERGY_ELEC_ACCUM_DEL*	watt-hour	Active Energy Delivered
ENERGY_ELEC_ACCUM_NET*	watt-hour	Active Energy Net
ENERGY_ELEC_ACCUM*	watt-hour	Total Active Energy
ENERGY_ELEC_ACCUM_RE-ACT_REC*	watt-hour	Positive Reactive Energy
ENERGY_ELEC_ACCUM_RE-ACT_DEL*	watt-hour	Negative Reactive Energy
ENERGY_ELEC_ACCUM_RE-ACT_NET*	watt-hour	Reactive Energy Net
ENERGY_ELEC_ACCUM_REACT*	watt-hour	Total Reactive Energy
ENERGY_ELEC_ACCUM_APPAR*	watt-hour	Total Apparent Energy
DEMAND_POS	watt	Positive Active Demand, 3-Phase, Average Demand
DEMAND_REACT_POS	volt-amp-reactive	Positive Reactive Demand, 3-phase, Average Demand
DEMAND_NEG	watt	Negative Active Demand, 3-Phase, Average Demand
DEMAND_REACT_NEG	volt-amp-reactive	Negative Reactive Demand, 3-Phase, Average Demand
DEMAND_APPAR	volt-amp	Apparent Demand, 3-Phase, Average Demand
DEMAND_PEAK_POS	watt	Positive Active Demand, 3-Phase, Max Average Demand
DEMAND_REACT_PEAK_POS	volt-amp-reactive	Positive Reactive Demand, 3-phase, Max Average Demand
DEMAND_PEAK_NEG	watt	Negative Active Demand, 3-Phase, Max Average Demand
DEMAND_REACT_PEAK_NEG	volt-amp-reactive	Negative Reactive Demand, 3-Phase, Max Average Demand
DEMAND_APPAR_PEAK	volt-amp	Apparent Demand, 3-Phase, Max Average Demand
VOLTAGE_THD-A	percent	Voltage A-N %THD
VOLTAGE_THD-B	percent	Voltage, B-N %THD
VOLTAGE_THD-C	percent	Voltage, C-N % THD
CURRENT-THD-A	percent	Current, A %THD

Object Name	Unit of Measurement	Description
CURRENT-THD-B	percent	Current, B % THD
CURRENT-THD-C	percent	Current, C % THD

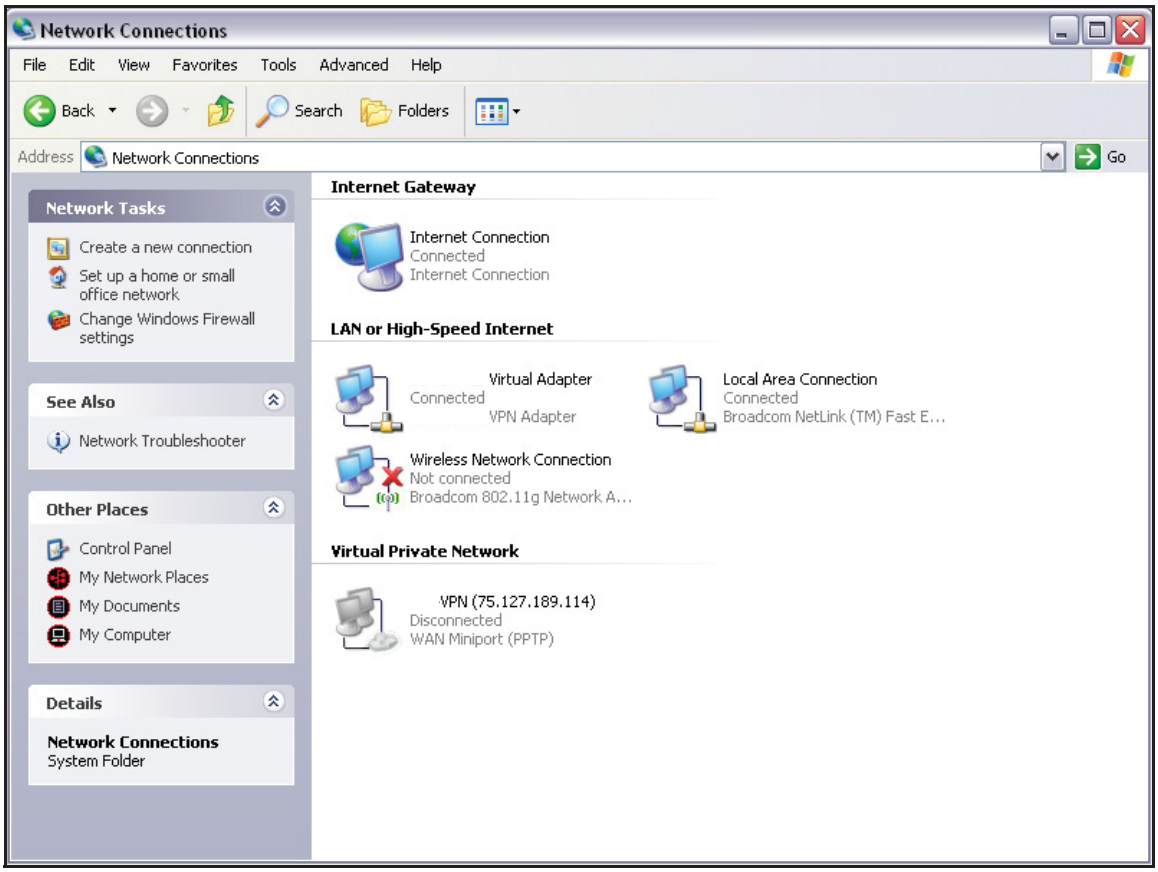
* For optimal accuracy and resolution the accumulators' attributes are factory preset to: 6 digits, no fractions – zero decimal places and kilo multiplier (Modbus register address: 30,006, decimal). We recommended you maintain these settings all of the time.

7.3: Configuring the Shark® 100B Meter

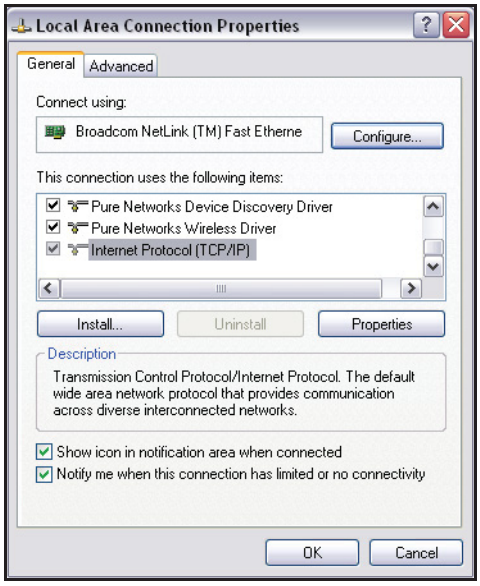
You must first set the Network configuration so you can communicate with the Shark® 100B meter. Follow these steps:

1. Configure your LAN connection to IP address 10.0.0.100, subnet mask 255.255.255.0:

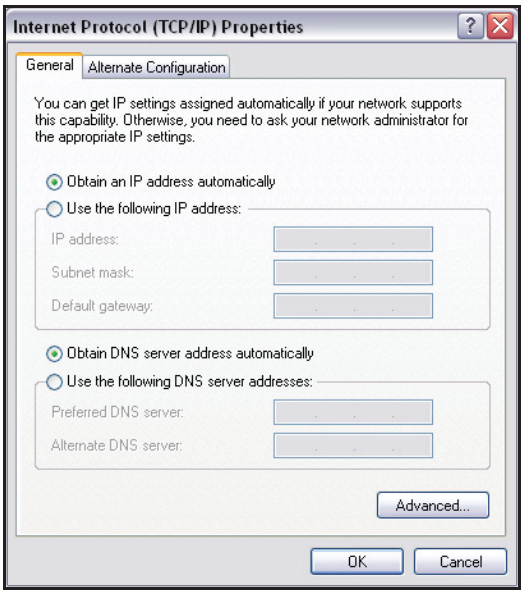
    a. Click **Start>Control Panel>Network Connections**. You will see a screen like the one shown below.



b. Right-click on the LAN connection you want to use and click **Properties**. You will see the screen shown below.



c. Scroll and highlight Internet Protocol TCP/IP and then click the **Properties** button. You will see the screen shown below.

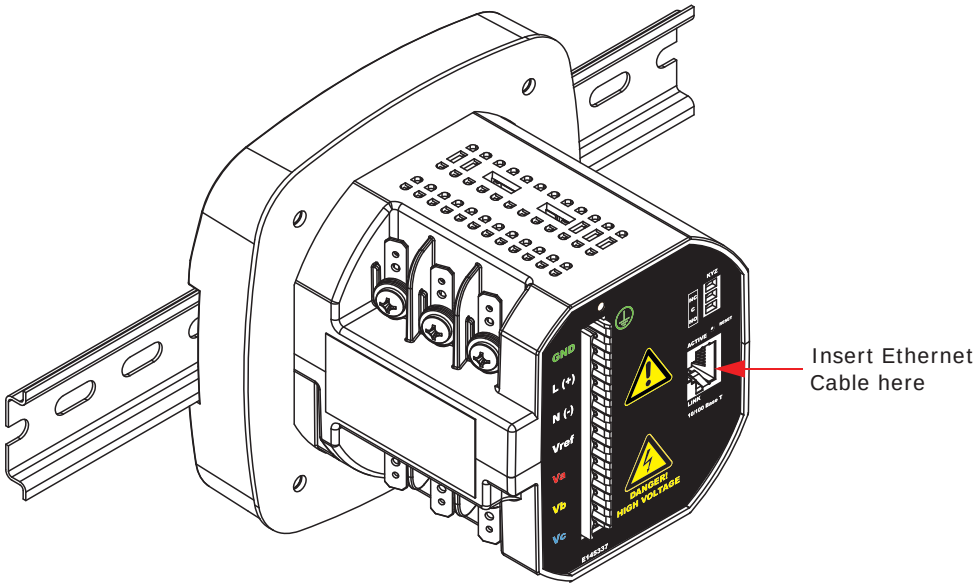

Internet Protocol (TCP/IP) Properties
General
Alternate Configuration
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
Subnet mask:
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Advanced...
OK
Cancel

d. Click the **Use the Following IP Address** radio button and enter:
IP Address: 10.0.0.100
Subnet Mask: 255.255.255.0

e. Click **OK**.

f. The Local Area Connection Properties screen redisplays. Click **OK**.

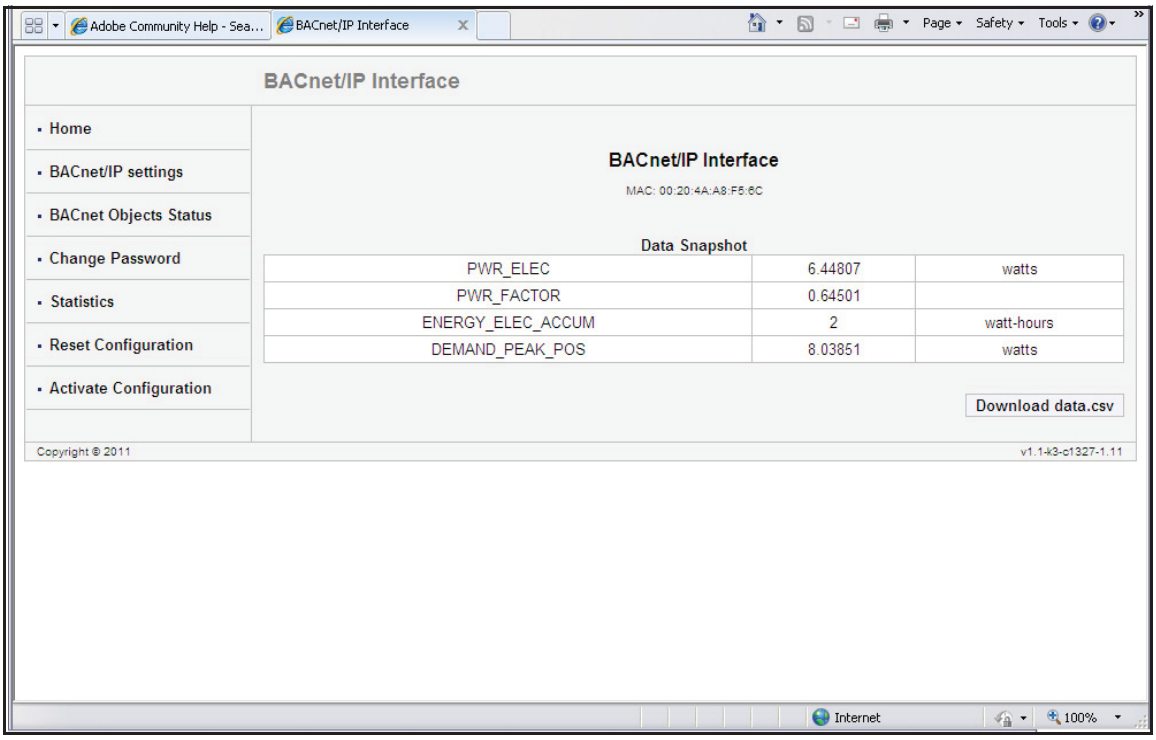
2. Use an Ethernet cable to connect the meter to your LAN port.



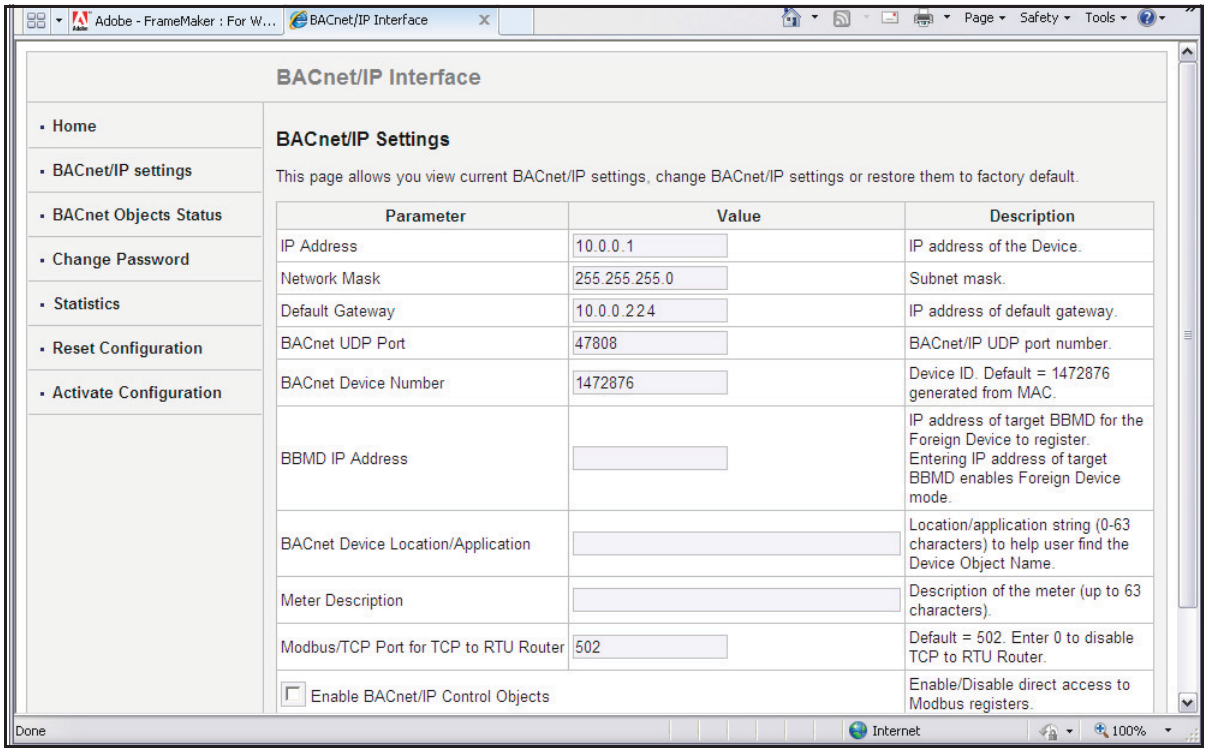
3. Open your web browser and connect to the meter at the default address by typing http://10.0.0.1.
NOTE: If this doesn't work, reset the meter to this default address by pressing the Reset button for 30 seconds. See Section 5.3.2.2 for instructions.

4. You will see a User Authentication screen. Enter the following default settings:
User name: admin
Password: admin

5. Click **OK**. You will see the BACnet Home webpage, shown below.



6. Click BACnet/IP Settings on the left side of the webpage to see the page shown on the next page. Use this page to change the default IP address (10.0.0.1) to an IP address in the same subnet as your Network. Contact your System Administrator if you are unsure of the correct address to use.



You can also change the following fields:

- Network Mask - the subnet mask. The default is 255.255.255.0.
- Default Gateway - the IP address of the gateway. The default is 10.0.0.224.
- BACnet UDP Port - the BACnet/IP UDP port number. The default is 47808. In some cases, e.g., if it is necessary for two groups of BACnet devices to be set up independently on the same IP subnet, the UDP port can be configured locally to a different value.
- BACnet Device Number - a numeric code used to identify the meter. This number is auto-generated from the MAC address.
- BBMD IP Address - when a BBMD IP address is entered here it enables Foreign Device mode.
- BACnet Device Location/Application - a readable string of up to 63 characters that you can use to find the Device Object Name.

- Meter Description - optional field where you can enter a description of up to 63 characters which will be added as a prefix in the name of all registers representing the meter's BACnet objects.

- Modbus TCP Port for TCP to RTU Router - the default port is 502. As long as this field is not 0, the router is enabled, which lets the meter communicate with Modbus TCP/IP Master devices.

- Enable BACnet/IP Control Objects - Check this box to allow direct access to Modbus registers. If enabled, the Control Objects are represented by the following three Analog-Value BACnet Objects:

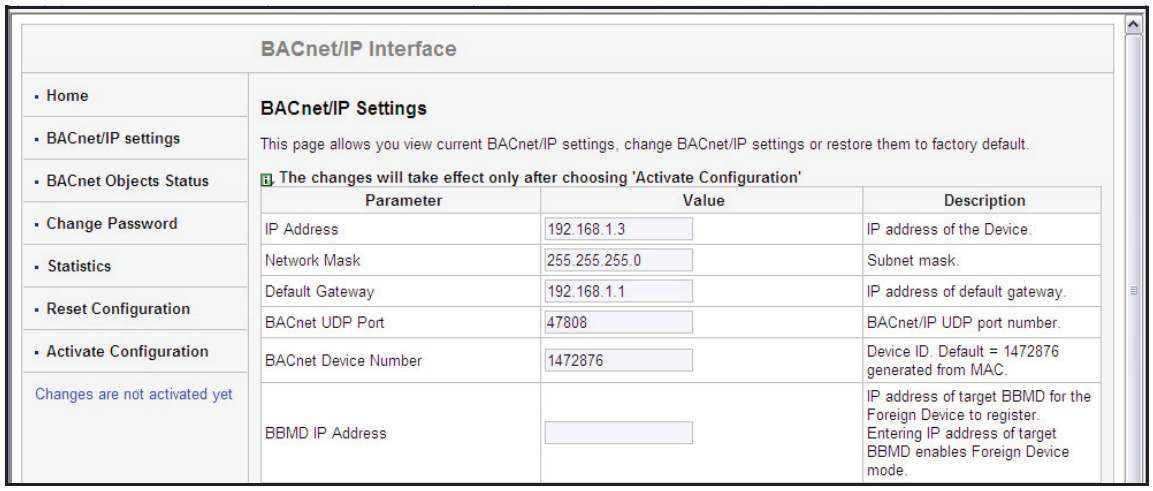
  1. 500001 is a writeable object called MOD_ID_TARGET ("target device identifier to be read/written"). Since the meter has a hard-coded Modbus address of "1" only this value needs to be entered before first access to a Modbus register. The default = -1.0. -1.0 also means do not execute #500003 (neither read nor write).

  2. 500002 is a writeable object called MOD_REGISTER ("register to be read/written"); for example, "1000" to access the first register of volts A-N. The default = -1.0 after any reboot. -1.0 also means do not execute #500003 (neither read nor write).

  3. 500003 is a readable/writeable value called MOD_VALUE ("value to be read from or written to select register").
     The MOD_REGISTER resets with -1.0 after each Read/Write (whether or not successful), from/to MOD_VALUE with valid MOD_ID_TARGET and MOD_REGISTER. MOD_REGISTER will also be set to -1.0 30 seconds after it is written to.

7. Click the **Advanced** button to display additional settings. **We recommend you do not change any Advanced setting.**

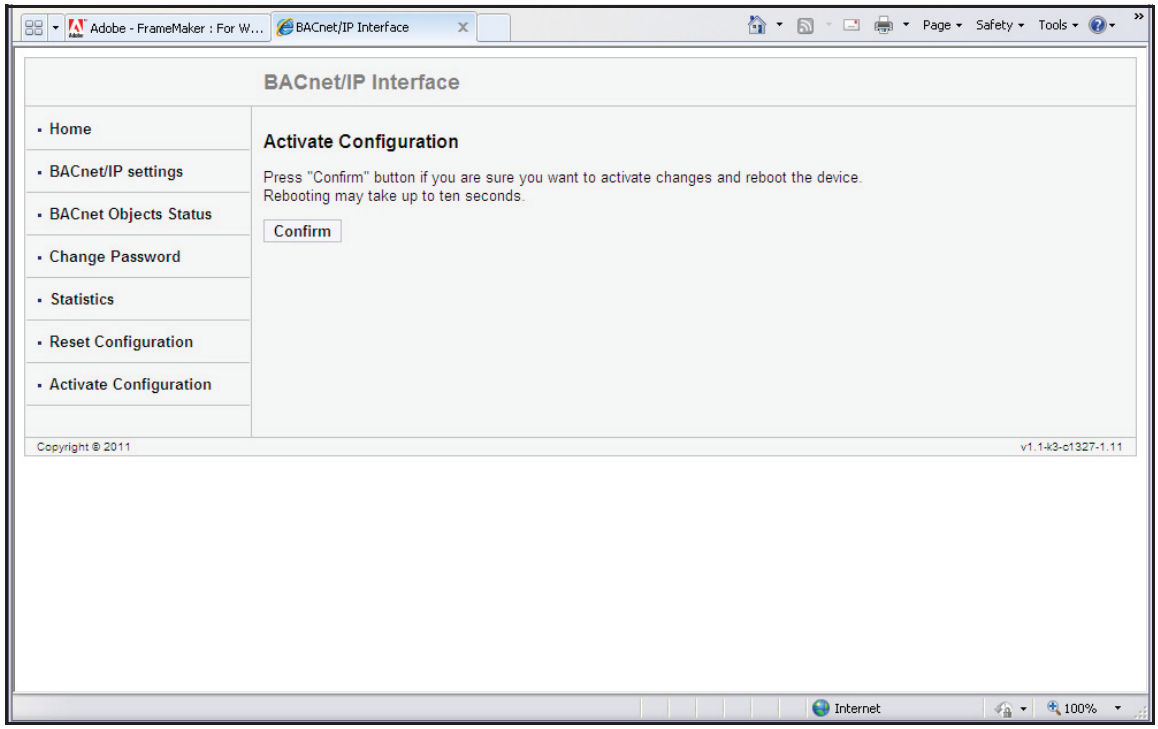
8. Click **OK** process your changes. You will see the following message:



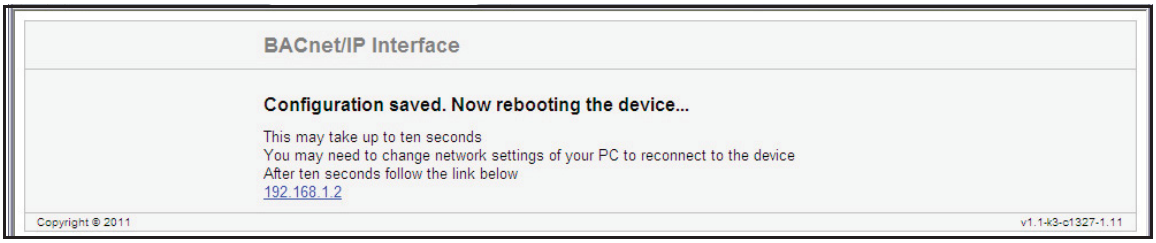
You still need to activate the configuration for the changes to take effect.

NOTE: You can change all settings back to their default by clicking the **Restore Default** button at the bottom of the page.

9. Click Activate Configuration from the left side of the webpage to implement any changes you made. You will see the page shown below.



10. Click the **Confirm** button to process the changes. You will see the message shown below.


BACnet/IP Interface
Configuration saved. Now rebooting the device...
This may take up to ten seconds
You may need to change network settings of your PC to reconnect to the device
After ten seconds follow the link below
192.168.1.2
Copyright © 2011
v1.1-k3-c1327-1.11

11. The meter resets. Connect the meter's Ethernet cable to your Network (remove it from your PC). You can now connect to the meter through your Network using the new IP address.

7.4: Using the Shark® 100B Meter's Web Interface

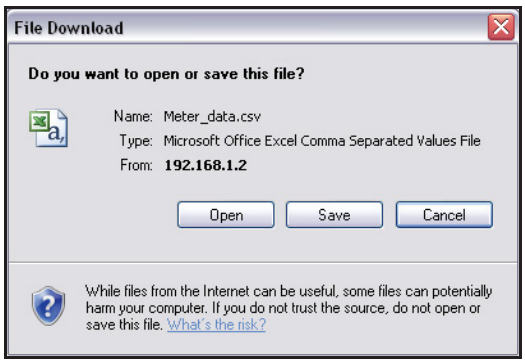
As shown in Section 7.3, you can use the meter's web interface to change the IP address and other Network parameters. You can also view information and readings using the web interface. This section explains the webpages other than the BACnet/IP Settings and Activate Configuration webpages, which are explained in Section 7.3.

Home Webpage

The Home webpage is shown at the top of page 6. It is the first page you see when you connect to the meter.

NOTE: To access this webpage from any of the other pages, click Home on the left side of the page.

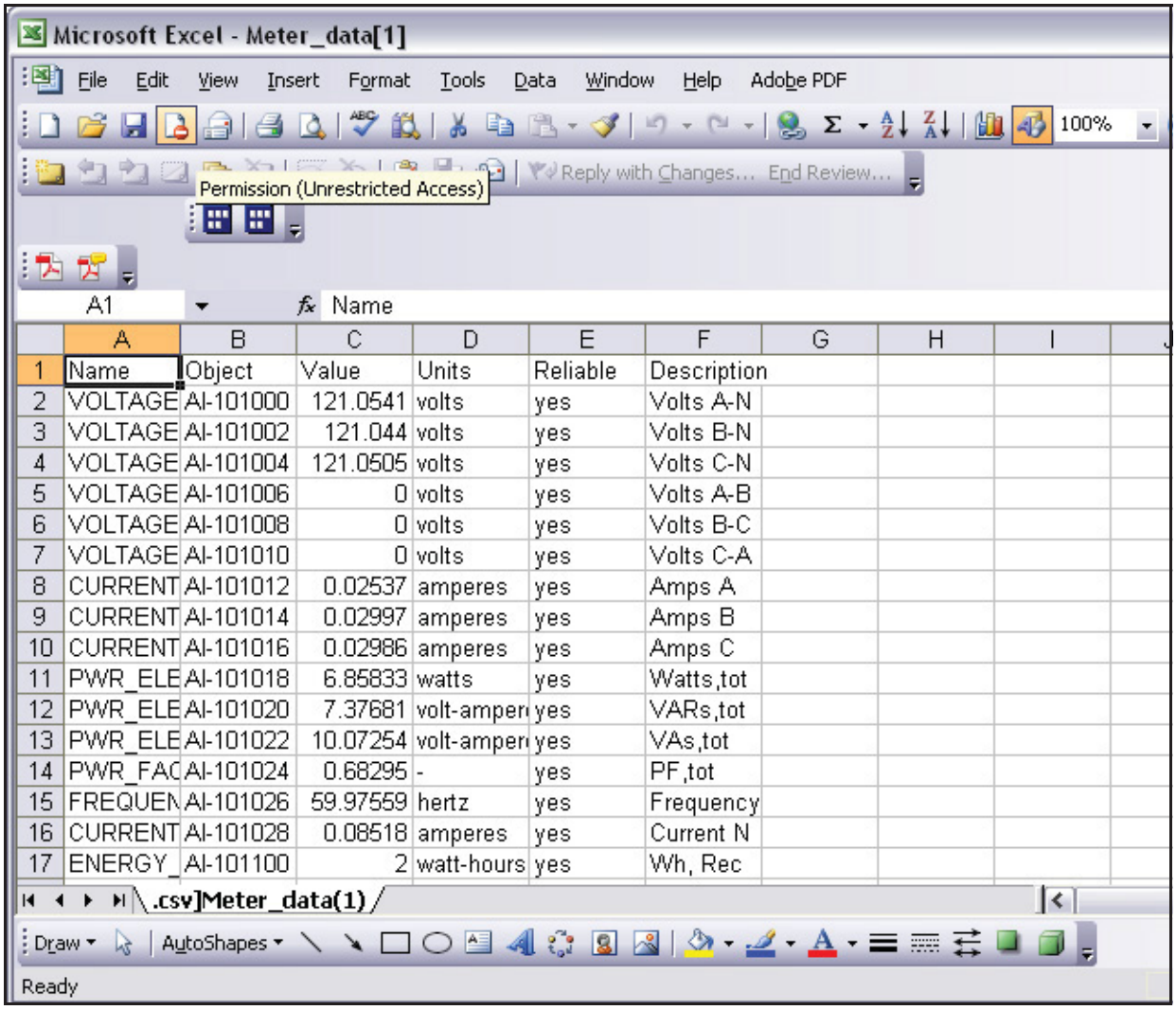
This webpage shows the current power, power factor, accumulated energy, and peak demand readings from the meter. You can download all of the meter's BACnet data by clicking the **Download data.csv** button. You will see the following screen:


File Download
Do you want to open or save this file?
Name: Meter_data.csv
Type: Microsoft Office Excel Comma Separated Values File
From: 192.168.1.2
Open
Save
Cancel
While files from the Internet can be useful, some files can potentially harm your computer. If you do not trust the source, do not open or save this file. What's the risk?

This screen gives you the option to open or save an Excel file with the BACnet meter data.

- Click **Open** to open an Excel file with the meter's BACnet data.
- Click **Save** to save a copy of the Excel file.
- Click **Cancel** to close the screen without opening or saving the file.

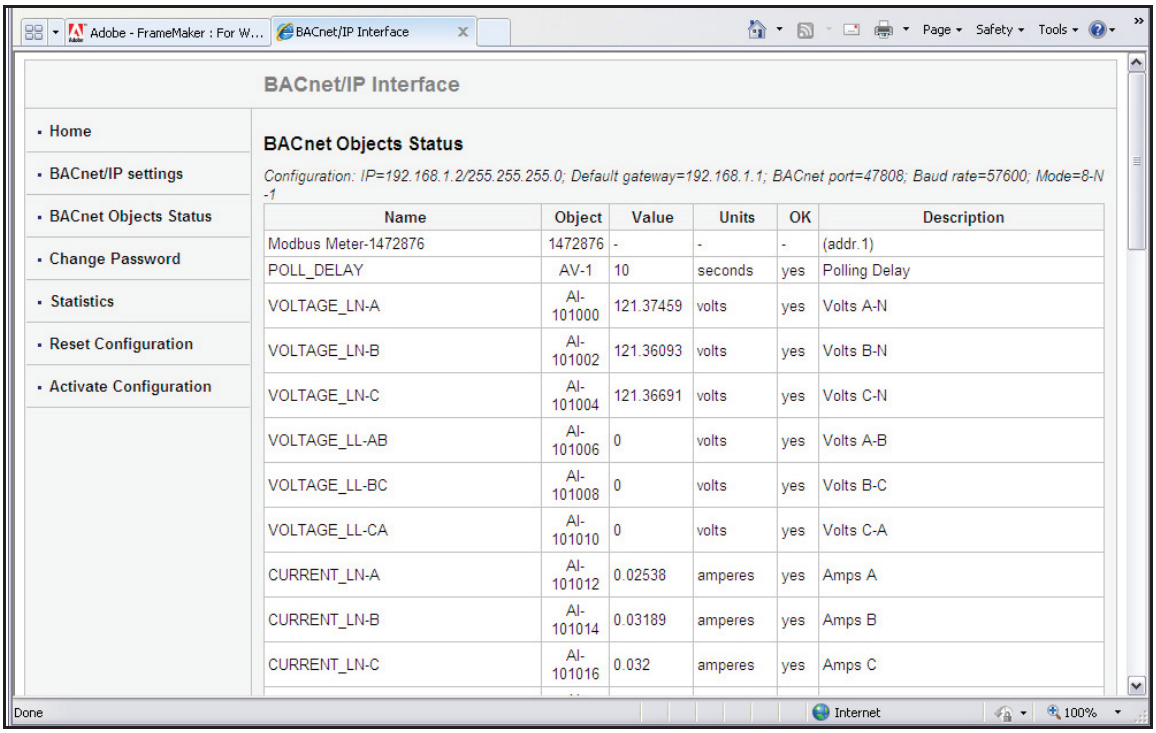
An example file is shown below:



	A	B	C	D	E	F
1	Name	Object	Value	Units	Reliable	Description
2	VOLTAGE	AI-101000	121.0541	volts	yes	Volts A-N
3	VOLTAGE	AI-101002	121.044	volts	yes	Volts B-N
4	VOLTAGE	AI-101004	121.0505	volts	yes	Volts C-N
5	VOLTAGE	AI-101006	0	volts	yes	Volts A-B
6	VOLTAGE	AI-101008	0	volts	yes	Volts B-C
7	VOLTAGE	AI-101010	0	volts	yes	Volts C-A
8	CURRENT	AI-101012	0.02537	amperes	yes	Amps A
9	CURRENT	AI-101014	0.02997	amperes	yes	Amps B
10	CURRENT	AI-101016	0.02986	amperes	yes	Amps C
11	PWR_ELE	AI-101018	6.85833	watts	yes	Watts,tot
12	PWR_ELE	AI-101020	7.37681	volt-amper	yes	VARs,tot
13	PWR_ELE	AI-101022	10.07254	volt-amper	yes	VAs,tot
14	PWR_FAC	AI-101024	0.68295	-	yes	PF,tot
15	FREQUEN	AI-101026	59.97559	hertz	yes	Frequency
16	CURRENT	AI-101028	0.08518	amperes	yes	Current N
17	ENERGY_	AI-101100	2	watt-hours	yes	Wh, Rec

BACnet Objects Status Webpage

Click BACnet Objects Status on the left side of the webpage to view readings for the meter's embedded BACnet objects. You will see a screen like the one shown below.



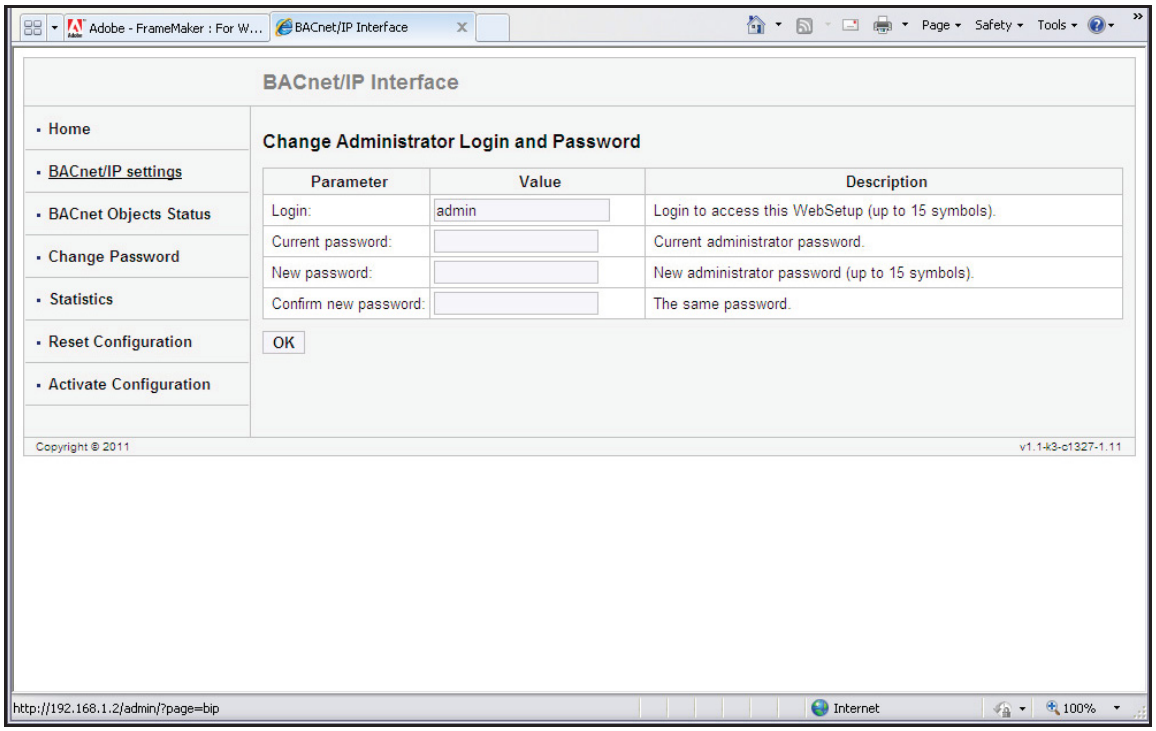
Name	Object	Value	Units	OK	Description
Modbus Meter-1472876	1472876	-	-	-	(addr.1)
POLL_DELAY	AV-1	10	seconds	yes	Polling Delay
VOLTAGE_LN-A	AI-101000	121.37459	volts	yes	Volts A-N
VOLTAGE_LN-B	AI-101002	121.36093	volts	yes	Volts B-N
VOLTAGE_LN-C	AI-101004	121.36691	volts	yes	Volts C-N
VOLTAGE_LL-AB	AI-101006	0	volts	yes	Volts A-B
VOLTAGE_LL-BC	AI-101008	0	volts	yes	Volts B-C
VOLTAGE_LL-CA	AI-101010	0	volts	yes	Volts C-A
CURRENT_LN-A	AI-101012	0.02538	amperes	yes	Amps A
CURRENT_LN-B	AI-101014	0.03189	amperes	yes	Amps B
CURRENT_LN-C	AI-101016	0.032	amperes	yes	Amps C

Scroll to see all of the objects on the screen. The following items are shown for each BACnet Object:

- Name
- Object
- Value
- Units
- OK (Reliability)
- Description

Change Password Webpage

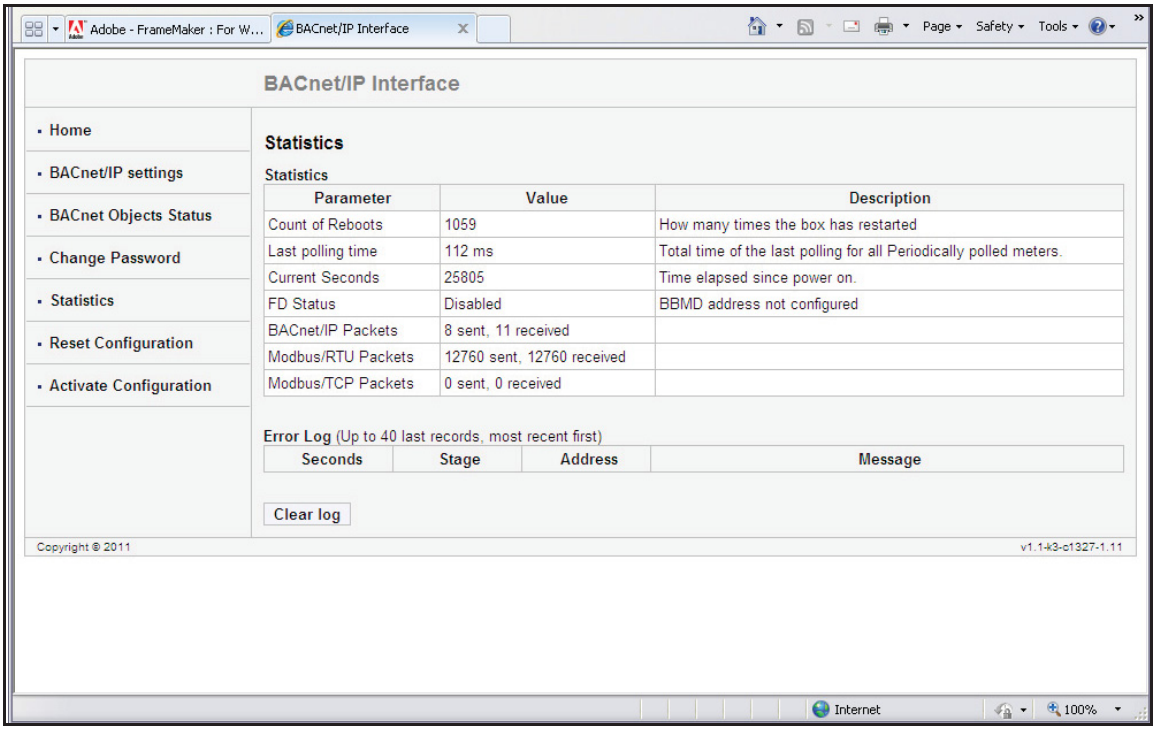
Click Change Password on the left side of the webpage to access the page shown below.



Use this page to change the Administrator Login and Password for this interface. We recommend that you change the Login and Password rather than continuing to use the default sign-on (be sure to store this information someplace safe).

Statistics Webpage

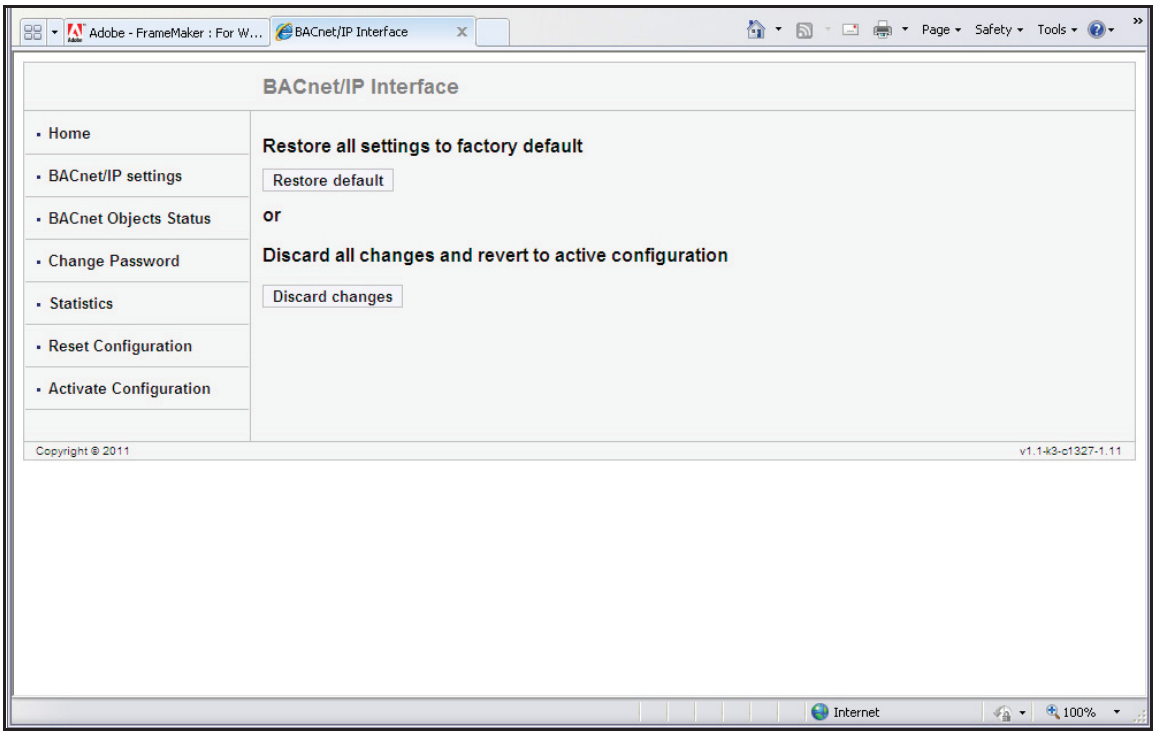
Click Statistics on the left side of the webpage to access the page shown below.



This page lists information and any Error log for the meter. To erase the Error log, click the **Clear Log** button.

Reset Configuration Webpage

Click Reset Configuration on the left side of the webpage if you want to set the configuration back to its default or last configuration. You will see the page shown below.



- Click the **Restore Default** button to restore all settings to the factory default values.
- Click the **Discard Changes** button to restore all settings to the last saved configuration.

7.5: Using the Shark® 100B in a BACnet Application

Once you have configured the Shark® 100B meter, you can use it as a standard BACnet server in any BACnet application. As there are many kinds of BACnet applications, we recommend you consult your application's instructions for details.

In addition to integrating with BACnet applications, the Shark® 100B meter can also be accessed through Communicator EXT™ software (see Chapter 6 and the *Communicator EXT™ 4.0 and MeterManager EXT Software User Manual*). Additionally, all of the BACnet data can be polled through the Modbus registers (see Appendix B for the Modbus map).

8: Using the Shark® 50B Meter

8.1: Introduction

The Shark® 50B power meter communicates BACnet MS/TP protocol though its RS485 serial port, allowing it to act as a BACnet device in any BACnet application. The meter also has a Web interface via its RJ45 Ethernet port that you can use to remotely set up the BACnet MS/TP and for Modbus TCP/IP configuration. The Ethernet port can also track energy readings through the internet using any standard Web browser. Section 7.1.1 gives an introduction to the BACnet protocol. The Shark® 50B meter uses BACnet MS/TP (master-slave/token-passing), which is designed to run at speeds of 1 Mbps or less over twisted pair
wiring, and in which the device takes turns being a master and a slave, dependent on whether it is sending or receiving data.

8.2: Shark® 50B Meter's BACnet Objects

The Shark® 50B meter's BACnet/MSTP implementation has 34 predefined objects of electrical measurements. No programming or mapping is necessary to use these BACnet objects. The object's names easily identify the measurements they contain.

All of the objects, with the exception of Modbus Meter and POLL_DELAY are AI (analog input) Object type. The following table lists each of the objects with their units of measurement and description.

Object Name	Unit of Measurement	Description
Modbus Meter-147222	none	(Addr. 1)
POLL_DELAY	AV-1	Polling Delay
VOLTAGE_LN-A	volt	Voltage A-N
VOLTAGE_LN-B	volt	Voltage B-N
VOLTAGE_LN-C	volt	Voltage C-N
VOLTAGE_LL-AB	volt	Voltage A-B
VOLTAGE_LL-BC	volt	Voltage B-C
VOLTAGE_LL-CA	volt	Voltage C-A
CURRENT_LN-A	amp	Current A
CURRENT_LN-B	amp	Current B

Object Name	Unit of Measurement	Description
CURRENT_LN-C	amp	Current C
PWR_ELEC	watt	Total Active Power
PWR_ELEC_REACT	volt-amp-reactive	Total Reactive Power
PWR_ELEC_APPAR	volt-amp	Total Apparent Power
PWR_FACTOR	---	Total Power Factor
FREQUENCY	Hertz	Frequency
CURRENT_NG	amp	Neutral Current
ENERGY_ELEC_ACCUM_REC*	watt-hour	Active Energy Received
ENERGY_ELEC_ACCUM_DEL*	watt-hour	Active Energy Delivered
ENERGY_ELEC_ACCUM_NET*	watt-hour	Active Energy Net
ENERGY_ELEC_ACCUM*	watt-hour	Total Active Energy
ENERGY_ELEC_ACCUM_RE-ACT_REC*	watt-hour	Positive Reactive Energy
ENERGY_ELEC_ACCUM_RE-ACT_DEL*	watt-hour	Negative Reactive Energy
ENERGY_ELEC_ACCUM_RE-ACT_NET*	watt-hour	Reactive Energy Net
ENERGY_ELEC_ACCUM_REACT*	watt-hour	Total Reactive Energy
ENERGY_ELEC_ACCUM_APPAR*	watt-hour	Total Apparent Energy
DEMAND_POS	watt	Positive Active Demand, 3-Phase, Average Demand
DEMAND_REACT_POS	volt-amp-reactive	Positive Reactive Demand, 3-phase, Average Demand
DEMAND_NEG	watt	Negative Active Demand, 3-Phase, Average Demand
DEMAND_REACT_NEG	volt-amp-reactive	Negative Reactive Demand, 3-Phase, Average Demand
DEMAND_APPAR	volt-amp	Apparent Demand, 3-Phase, Average Demand
DEMAND_PEAK_POS	watt	Positive Active Demand, 3-Phase, Max Average Demand
DEMAND_REACT_PEAK_POS	volt-amp-reactive	Positive Reactive Demand, 3-phase, Max Average Demand
DEMAND_PEAK_NEG	watt	Negative Active Demand, 3-Phase, Max Average Demand

Object Name	Unit of Measurement	Description
DEMAND_REACT_PEAK_NEG	volt-amp-reactive	Negative Reactive Demand, 3-Phase, Max Average Demand
DEMAND_APPAR_PEAK	volt-amp	Apparent Demand, 3-Phase, Max Average Demand

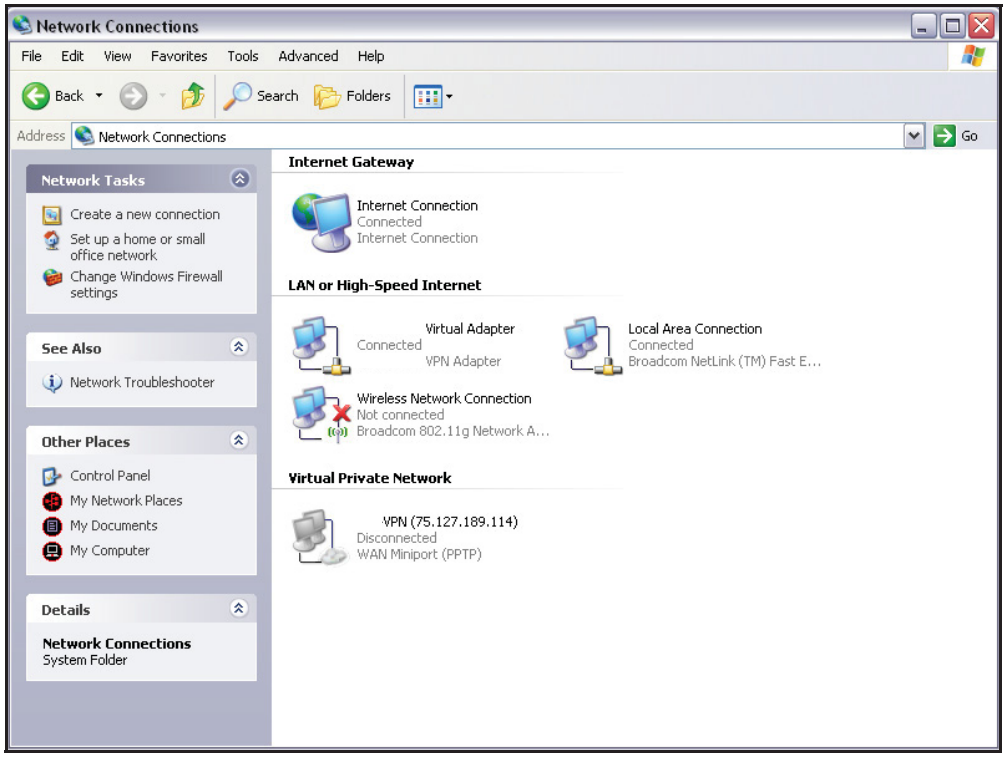
* For optimal accuracy and resolution the accumulators' attributes are factory preset to: 6 digits, no fractions – zero decimal places and kilo multiplier (Modbus register address: 30,006, decimal). We recommended you maintain these settings all of the time.

8.3: Configuring the Shark® 50B Meter

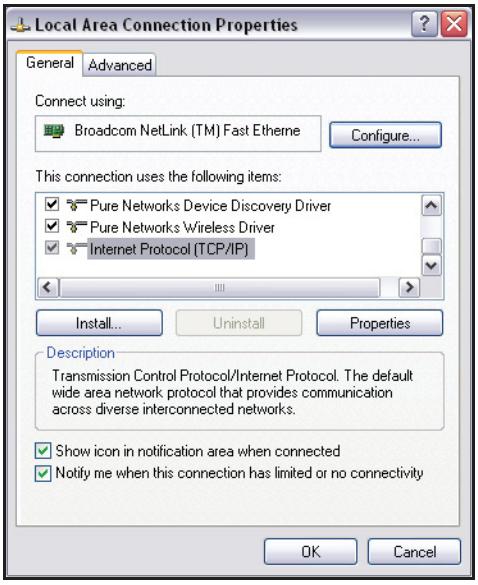
You must first set the Network configuration so you can communicate with the Shark® 50B meter through its Ethernet port. Follow these steps:

1. Configure your LAN connection to IP address 10.0.0.100, subnet mask 255.255.255.0:

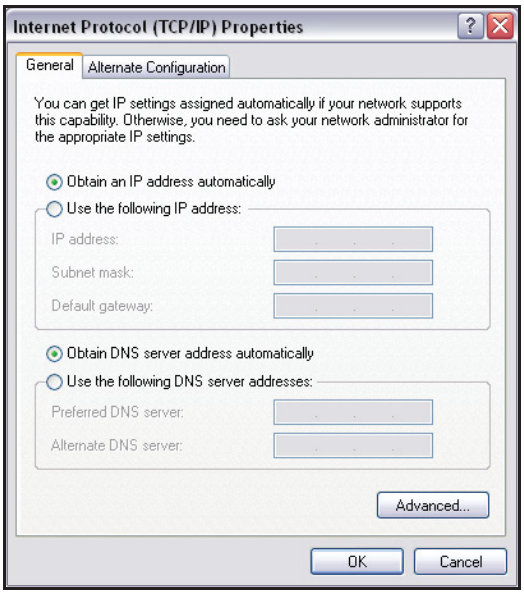
    a. Click Start>Control Panel>Network Connections. You will see a screen like the one shown below.



b. Right-click on the LAN connection you want to use and click Properties. You will see the screen shown below.



c. Scroll and highlight Internet Protocol TCP/IP and then click the Properties button. You will see the screen shown below.


Internet Protocol (TCP/IP) Properties
General
Alternate Configuration
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
Subnet mask:
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Advanced...
OK
Cancel

d. Click the Use the Following IP Address radio button and enter:

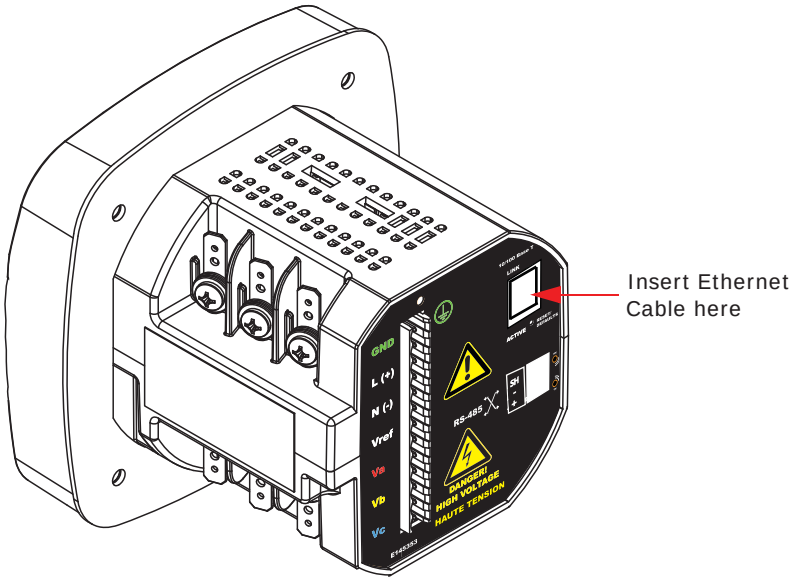
IP Address: 10.0.0.100

Subnet Mask: 255.255.255.0

e. Click OK.

f. The Local Area Connection Properties screen redisplays. Click OK.

2. Use an Ethernet cable to connect the meter to your LAN port.



3. Open your web browser and connect to the meter at the default address by typing http://10.0.0.1.

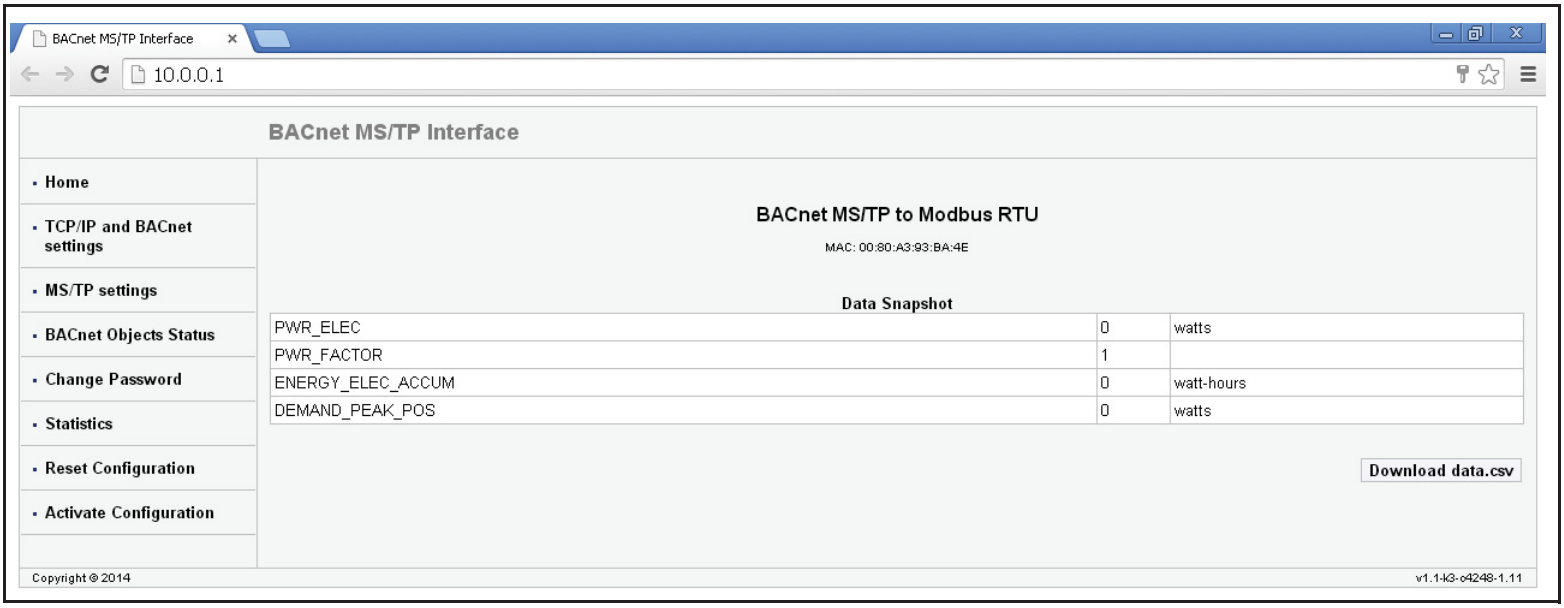
   NOTE: If this doesn't work, reset the meter to this default address by pressing the Reset button for 30 seconds. See Section 5.3.2.2 for instructions.

4. You will see a User Authentication screen. Enter the following default settings:

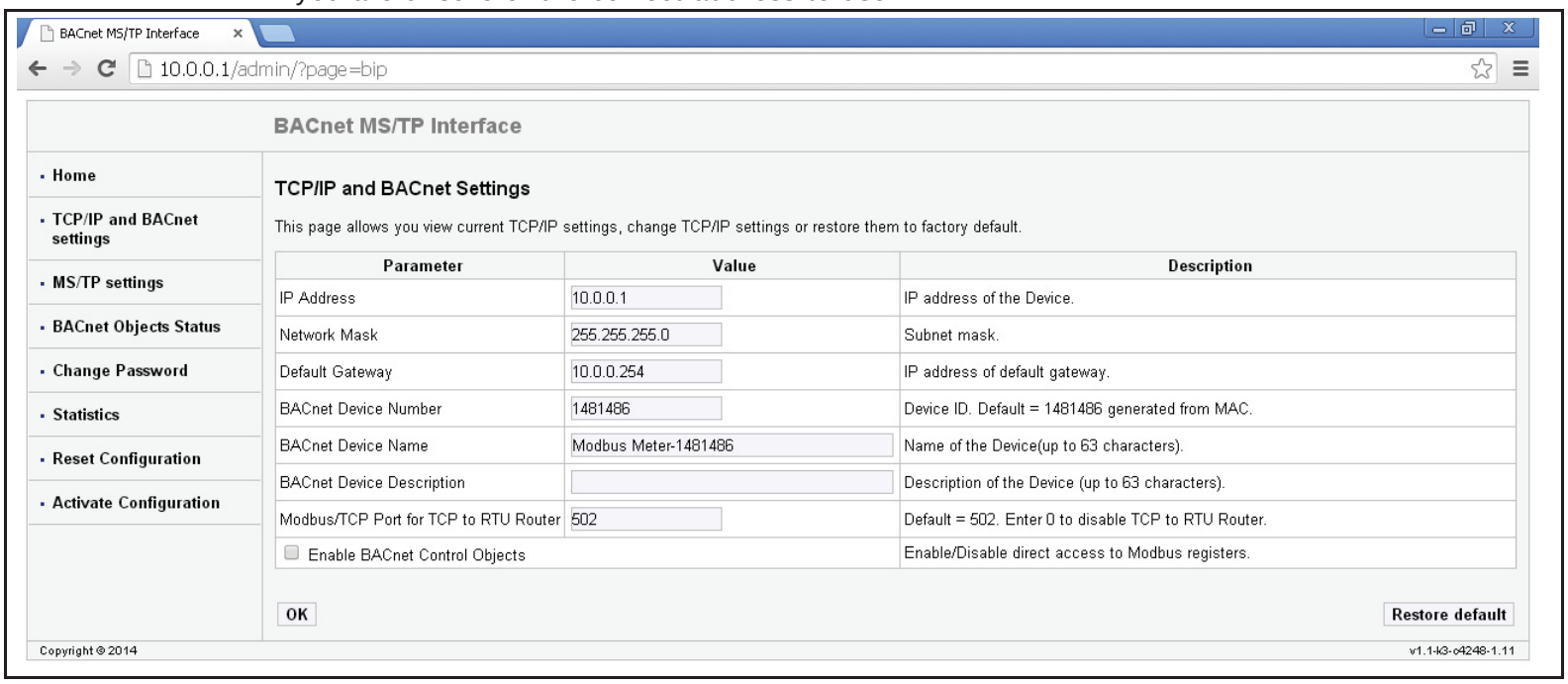
   User name: admin

   Password: admin

5. Click **OK**. You will see the BACnet MS/TP Interface webpage, shown below.



6. Click TCP/IP and BACnet Settings on the left side of the webpage to see the page shown below. Use this page to change the default IP address (10.0.0.1) to an IP address in the same subnet as your Network. Contact your System Administrator if you are unsure of the correct address to use.


BACnet MS/TP Interface
10.0.0.1/admin/?page=bip
BACnet MS/TP Interface
Home
TCP/IP and BACnet settings
MS/TP settings
BACnet Objects Status
Change Password
Statistics
Reset Configuration
Activate Configuration
TCP/IP and BACnet Settings
This page allows you view current TCP/IP settings, change TCP/IP settings or restore them to factory default.
Parameter | Value | Description
IP Address | 10.0.0.1 | IP address of the Device.
Network Mask | 255.255.255.0 | Subnet mask.
Default Gateway | 10.0.0.254 | IP address of default gateway.
BACnet Device Number | 1481486 | Device ID. Default = 1481486 generated from MAC.
BACnet Device Name | Modbus Meter-1481486 | Name of the Device(up to 63 characters).
BACnet Device Description | | Description of the Device (up to 63 characters).
Modbus/TCP Port for TCP to RTU Router | 502 | Default = 502. Enter 0 to disable TCP to RTU Router.
Enable BACnet Control Objects | | Enable/Disable direct access to Modbus registers.
OK
Restore default
Copyright © 2014
v1.1-k3-o4248-1.11

You can also change the following fields:

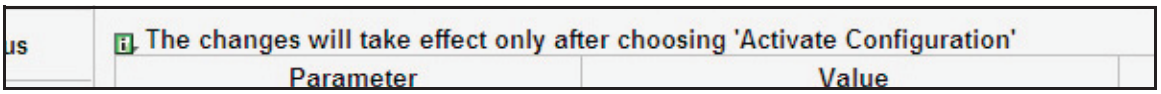
- Network Mask - the subnet mask. The default is 255.255.255.0.

- Default Gateway - the IP address of the gateway. The default is 10.0.0.224.
- BACnet Device Number - a numeric code used to identify the meter. This number is auto-generated from the MAC address.
- BACnet Device Name - field for the device name, which can be up to 63 characters in length.
- BACnet Device Description - optional field where you can enter a description of up to 63 characters which will be added as a prefix in the name of all registers representing the meter's BACnet objects.
- Modbus TCP Port for TCP to RTU Router - the default port is 502. As long as this field is not 0, the router is enabled, which lets the meter communicate with Modbus TCP/IP Master devices.
- Enable BACnet/IP Control Objects - Check this box to allow direct access to Modbus registers. If enabled, the Control Objects are represented by the following three Analog-Value BACnet Objects:
    a. 500001 is a writeable object called MOD_ID_TARGET ("target device identifier to be read/written"). Since the meter has a hard-coded Modbus address of "1" only this value needs to be entered before first access to a Modbus register. The default = -1.0. -1.0 also means do not execute #500003 (neither read nor write).

    b. 500002 is a writeable object called MOD_REGISTER ("register to be read/written"); for example, "1000" to access the first register of volts A-N. The default = -1.0 after any reboot. -1.0 also means do not execute #500003 (neither read nor write).

    c. 500003 is a readable/writeable value called MOD_VALUE ("value to be read from or written to select register").
    The MOD_REGISTER resets with -1.0 after each Read/Write (whether or not successful), from/to MOD_VALUE with valid MOD_ID_TARGET and MOD_REGISTER. MOD_REGISTER will also be set to -1.0 30 seconds after it is written to.

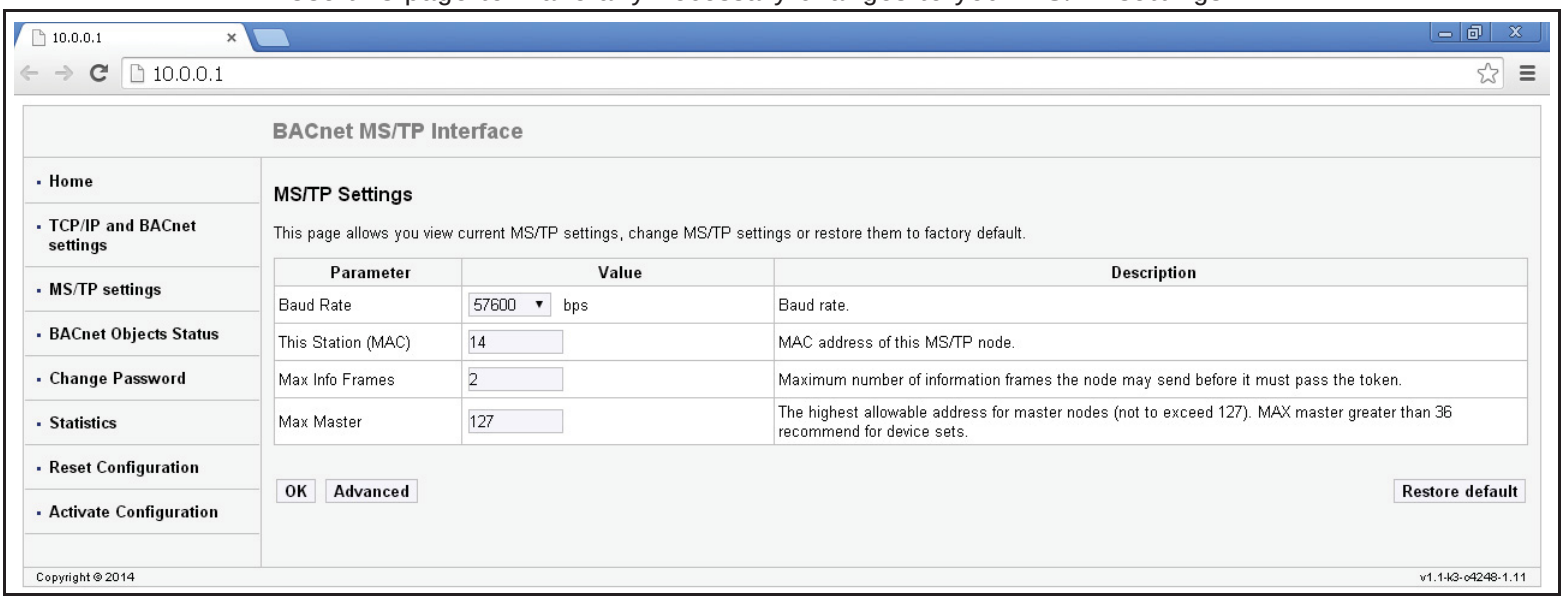
7. Click OK to process your changes. You will see the following message:



You still need to activate the configuration for the changes to take effect.

NOTE: You can change all settings back to their default by clicking the Restore Default button at the bottom right of the page.

8. Click MS/TP Settings on the left side of the webpage to see the page shown below. Use this page to make any necessary changes to your MS/TP settings.



You can change the following fields:

- Baud Rate - select the baud rate you need from the pull-down menu.
- This station (MAC) - the MAC address of this MS/TP node (the Shark® 50B meter).
- Max Info Frames - this is the maximum number of information frames the node is allowed to send before it needs to pass the token.
- Max Master - this is the highest allowable address for master nodes (cannot be higher than 127); a Max master greater than 36 is recommended for data sets.

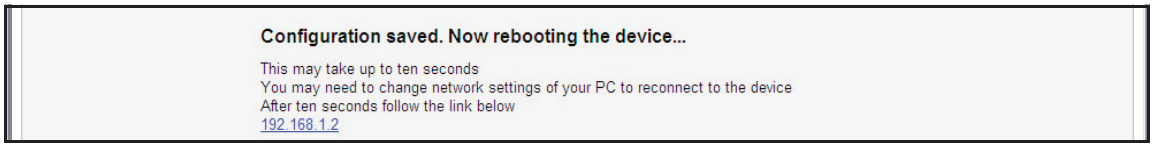
9. Click the Advanced button to display additional settings.

NOTE: We recommend you do not change any Advanced setting.

10. Click OK to process your changes.

11. Click Activate Configuration from the left side of the webpage to implement any changes you made. You will see the page shown below.

12. Click the Confirm button to process the changes. You will see the message shown below (the IP Address shown in the link is just an example).


Configuration saved. Now rebooting the device...
This may take up to ten seconds
You may need to change network settings of your PC to reconnect to the device
After ten seconds follow the link below
192.168.1.2

13. The meter resets. Connect the meter's Ethernet cable to your Network (remove it from your PC). You can now connect to the meter through your Network using the new IP address.

8.4: Using the Shark® 50B Meter's Web Interface

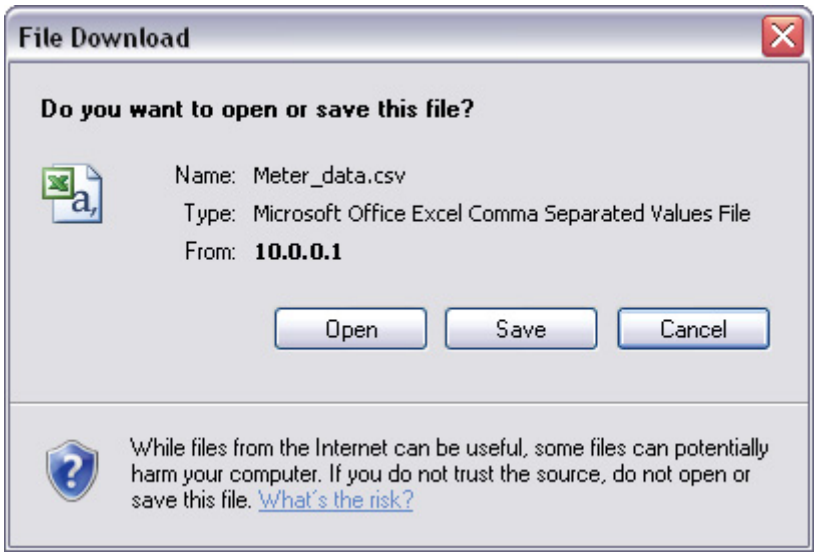
As shown in Section 8.3, you can use the meter's web interface to change the IP address and other Network parameters. You can also view information and readings using the web interface. This section explains the webpages other than the BACnet/IP Settings and Activate Configuration webpages, which are explained in Section 8.3.

Home Webpage

The Home webpage is shown at the top of page 6. It is the first page you see when you connect to the meter.

NOTE: To access this webpage from any of the other pages, click Home on the left side of the page.

This webpage shows the current power, power factor, accumulated energy, and peak demand readings from the meter. You can download all of the meter's BACnet data by clicking the Download data.csv button. You will see the following screen:

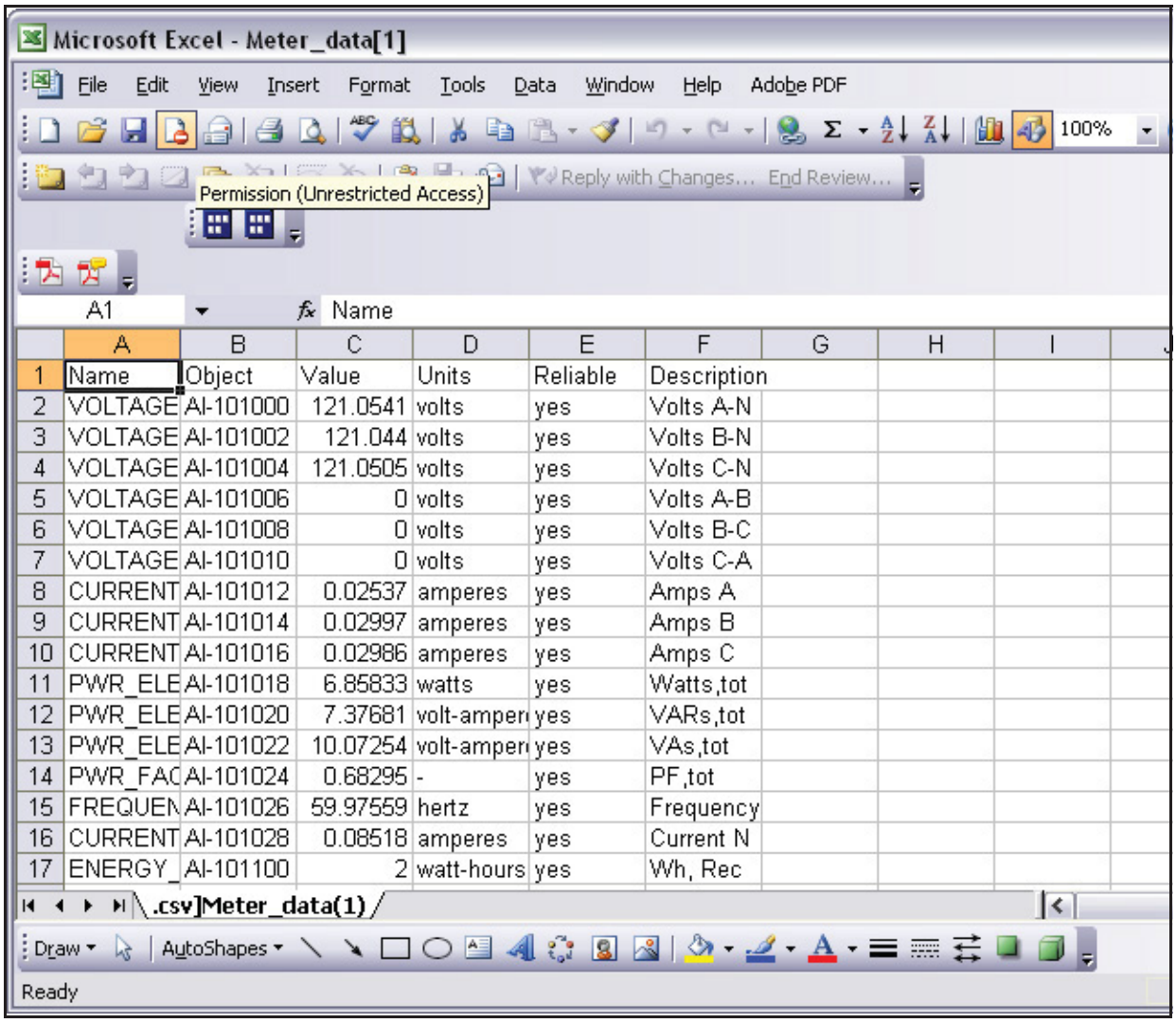

File Download
Do you want to open or save this file?
Name: Meter_data.csv
Type: Microsoft Office Excel Comma Separated Values File
From: 10.0.0.1
Open
Save
Cancel
While files from the Internet can be useful, some files can potentially harm your computer. If you do not trust the source, do not open or save this file. What's the risk?

This screen gives you the option to open or save an Excel file with the BACnet meter data.

- Click Open to open an Excel file with the meter's BACnet data.
- Click Save to save a copy of the Excel file.

- Click Cancel to close the screen without opening or saving the file.

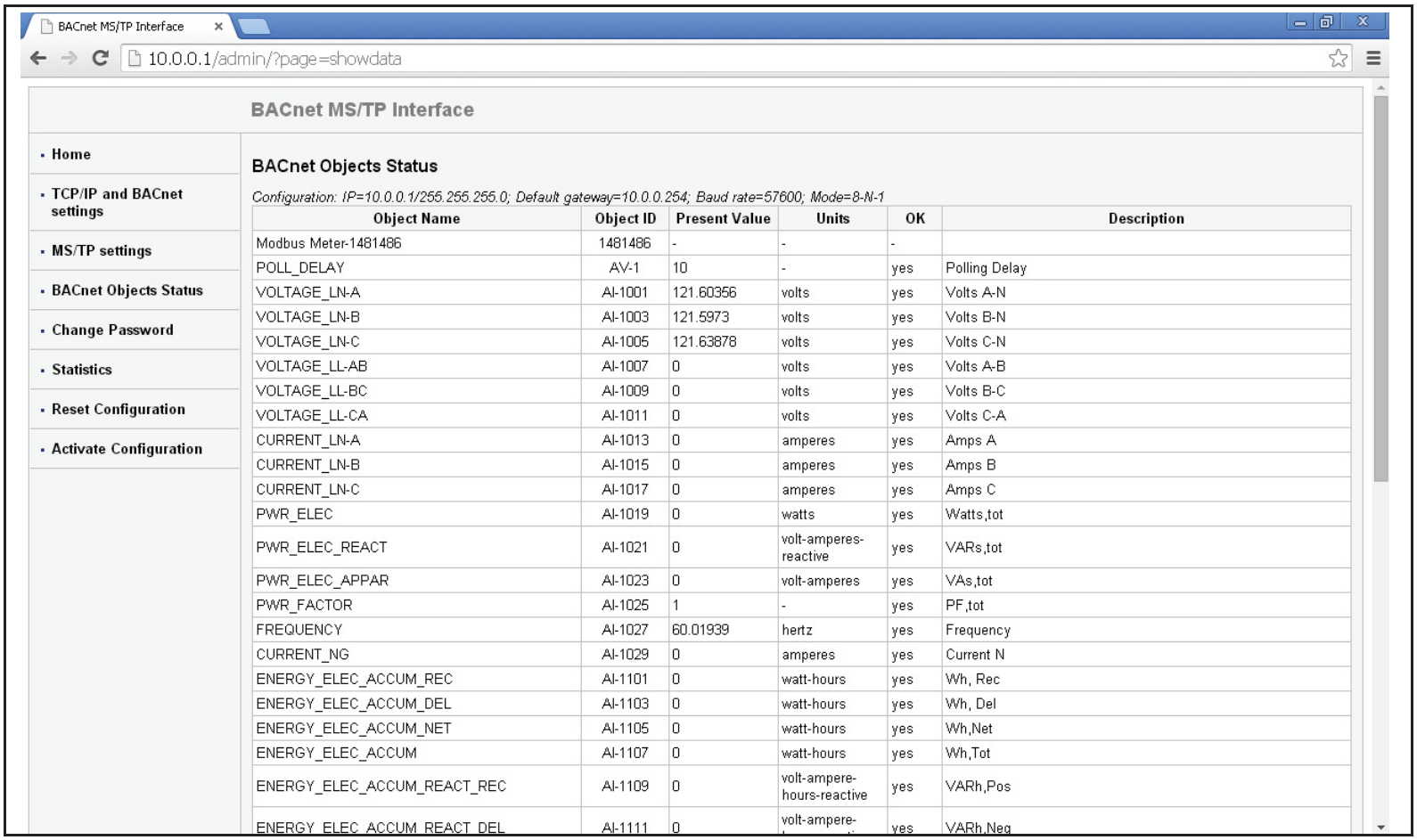
An example file is shown below:



	A	B	C	D	E	F
1	Name	Object	Value	Units	Reliable	Description
2	VOLTAGE	AI-101000	121.0541	volts	yes	Volts A-N
3	VOLTAGE	AI-101002	121.044	volts	yes	Volts B-N
4	VOLTAGE	AI-101004	121.0505	volts	yes	Volts C-N
5	VOLTAGE	AI-101006	0	volts	yes	Volts A-B
6	VOLTAGE	AI-101008	0	volts	yes	Volts B-C
7	VOLTAGE	AI-101010	0	volts	yes	Volts C-A
8	CURRENT	AI-101012	0.02537	amperes	yes	Amps A
9	CURRENT	AI-101014	0.02997	amperes	yes	Amps B
10	CURRENT	AI-101016	0.02986	amperes	yes	Amps C
11	PWR_ELE	AI-101018	6.85833	watts	yes	Watts,tot
12	PWR_ELE	AI-101020	7.37681	volt-amper	yes	VARs,tot
13	PWR_ELE	AI-101022	10.07254	volt-amper	yes	VAs,tot
14	PWR_FAC	AI-101024	0.68295	-	yes	PF,tot
15	FREQUEN	AI-101026	59.97559	hertz	yes	Frequency
16	CURRENT	AI-101028	0.08518	amperes	yes	Current N
17	ENERGY_	AI-101100	2	watt-hours	yes	Wh, Rec

BACnet Objects Status Webpage

Click BACnet Objects Status on the left side of the webpage to view readings for the meter's embedded BACnet objects. You will see a screen like the one shown below.



Object Name	Object ID	Present Value	Units	OK	Description
Modbus Meter-1481486	1481486	-	-	-	
POLL_DELAY	AV-1	10	-	yes	Polling Delay
VOLTAGE_LN-A	AI-1001	121.60356	volts	yes	Volts A-N
VOLTAGE_LN-B	AI-1003	121.5973	volts	yes	Volts B-N
VOLTAGE_LN-C	AI-1005	121.63878	volts	yes	Volts C-N
VOLTAGE_LL-AB	AI-1007	0	volts	yes	Volts A-B
VOLTAGE_LL-BC	AI-1009	0	volts	yes	Volts B-C
VOLTAGE_LL-CA	AI-1011	0	volts	yes	Volts C-A
CURRENT_LN-A	AI-1013	0	amperes	yes	Amps A
CURRENT_LN-B	AI-1015	0	amperes	yes	Amps B
CURRENT_LN-C	AI-1017	0	amperes	yes	Amps C
PWR_ELEC	AI-1019	0	watts	yes	Watts,tot
PWR_ELEC_REACT	AI-1021	0	volt-amperes-reactive	yes	VARs,tot
PWR_ELEC_APPAR	AI-1023	0	volt-amperes	yes	VAs,tot
PWR_FACTOR	AI-1025	1	-	yes	PF,tot
FREQUENCY	AI-1027	60.01939	hertz	yes	Frequency
CURRENT_NG	AI-1029	0	amperes	yes	Current N
ENERGY_ELEC_ACCUM_REC	AI-1101	0	watt-hours	yes	Wh, Rec
ENERGY_ELEC_ACCUM_DEL	AI-1103	0	watt-hours	yes	Wh, Del
ENERGY_ELEC_ACCUM_NET	AI-1105	0	watt-hours	yes	Wh,Net
ENERGY_ELEC_ACCUM	AI-1107	0	watt-hours	yes	Wh,Tot
ENERGY_ELEC_ACCUM_REACT_REC	AI-1109	0	volt-ampere-hours-reactive	yes	VARh,Pos
ENERGY_ELEC_ACCUM_REACT_DEL	AI-1111	0	volt-ampere-	yes	VARh,Neg

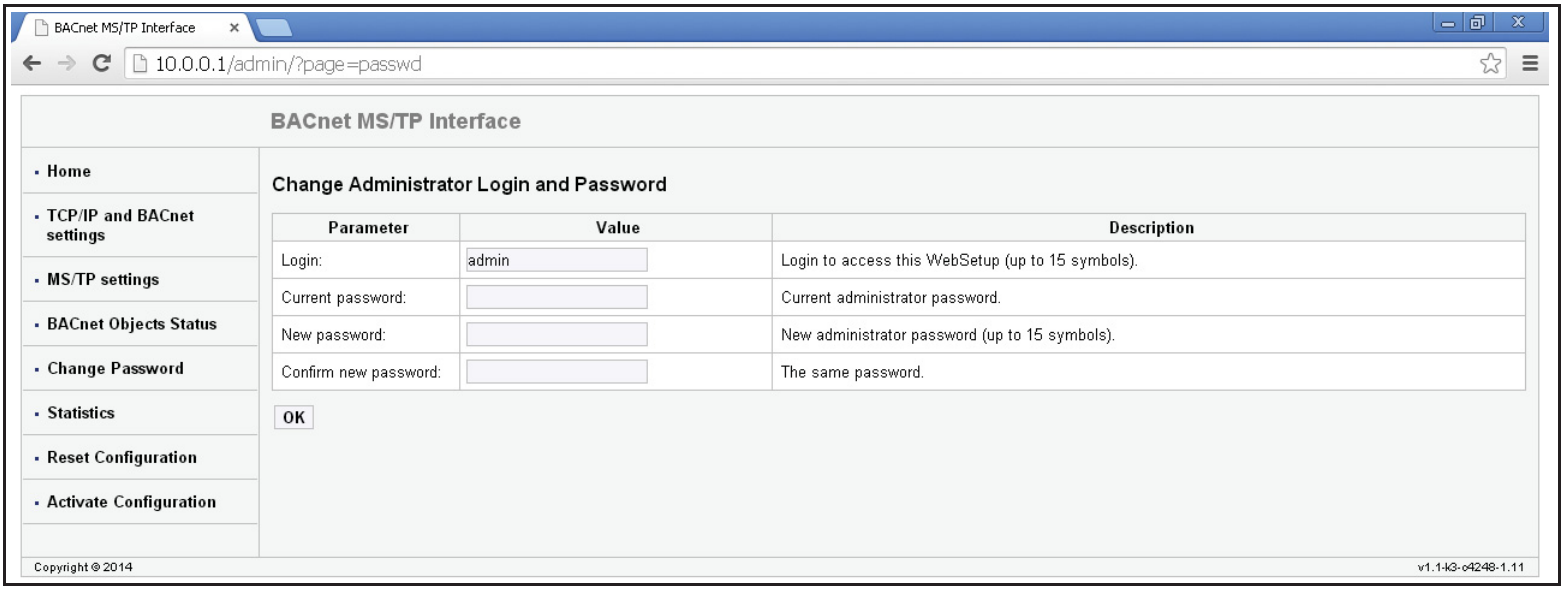
Scroll to see all of the objects on the screen. The following items are shown for each BACnet Object:

- Object Name
- Object ID
- Present Value
- Units
- OK (Reliability)

- Description

Change Password Webpage

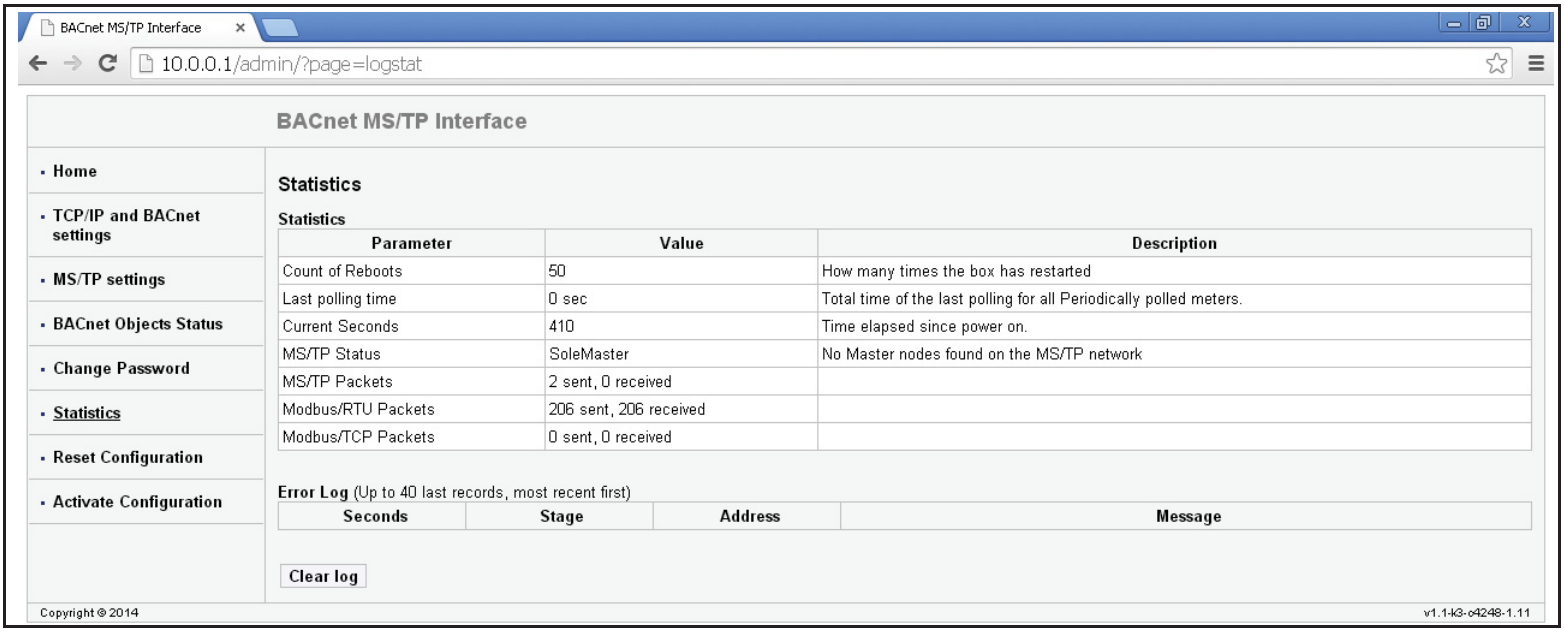
Click Change Password on the left side of the webpage to access the page shown below.



Use this page to change the Administrator Login and Password for this interface. We recommend that you change the Login and Password rather than continuing to use the default sign-on (be sure to store this information someplace safe).

Statistics Webpage

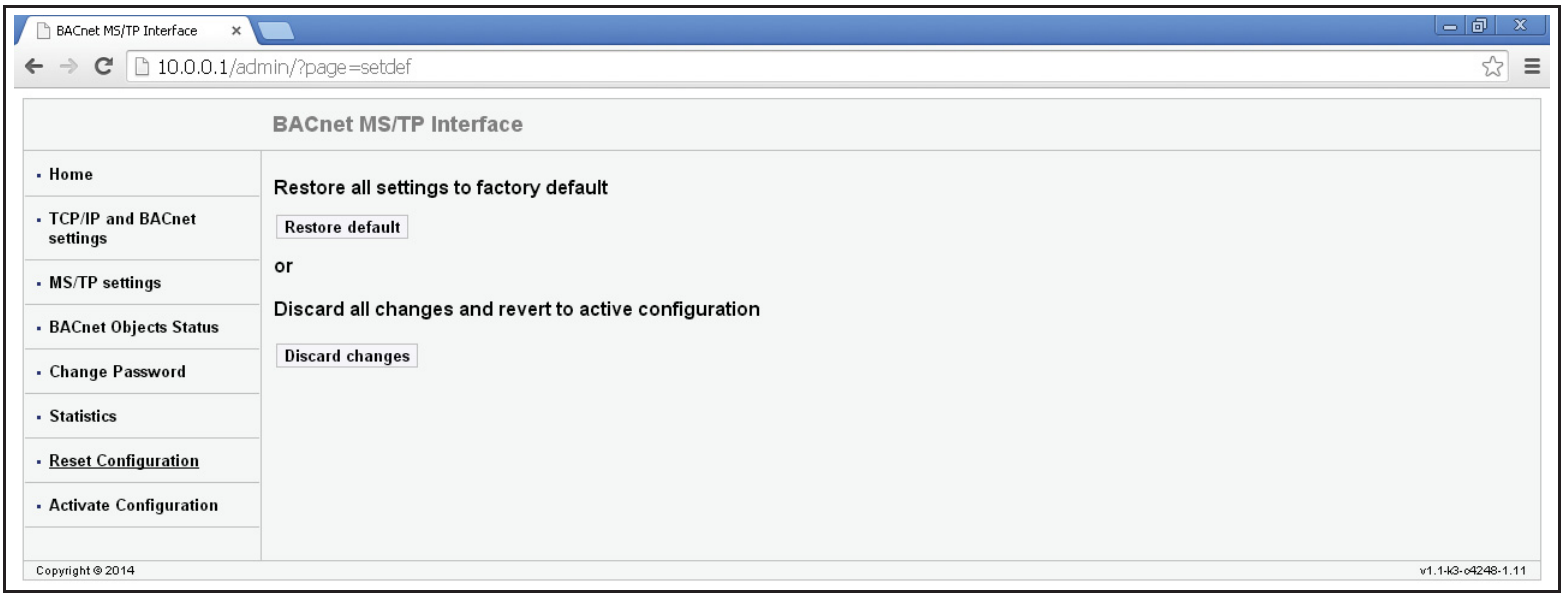
Click Statistics on the left side of the webpage to access the page shown below.



This page lists information and any Error log for the meter. To erase the Error log, click the Clear Log button.

Reset Configuration Webpage

Click Reset Configuration on the left side of the webpage if you want to set the configuration back to its default or last configuration. You will see the page shown below.



- Click the Restore Default button to restore all settings to the factory default values.
- Click the Discard Changes button to restore all settings to the last saved configuration.

8.5: Using the Shark® 50B in a BACnet Application

Once you have configured the Shark® 50B meter, you can use it as a standard BACnet client in any BACnet application. As there are many kinds of BACnet applications, we recommend you consult your application's instructions for details.

In addition to integrating with BACnet applications, the Shark® 50B meter can also be accessed through Communicator EXT™ 4.0 software (see Chapter 6 and the *Communicator EXT™ 4.0 and MeterManager EXT Software User Manual*). Additionally, all of the BACnet data can be polled through the Modbus registers (see Appendix B for the meter's Modbus map).

A: Shark® 100/50 Meter Navigation Maps

A.1: Introduction

You can configure the Shark® 100/50 meter and perform related tasks using the buttons on the meter face. Chapter 6 contains a description of the buttons on the meter face and instructions for programming the meter using them. The meter can also be programmed using software (see Chapter 6 and the *Communicator EXT™ 4.0 and MeterManager EXT Software User Manual*).

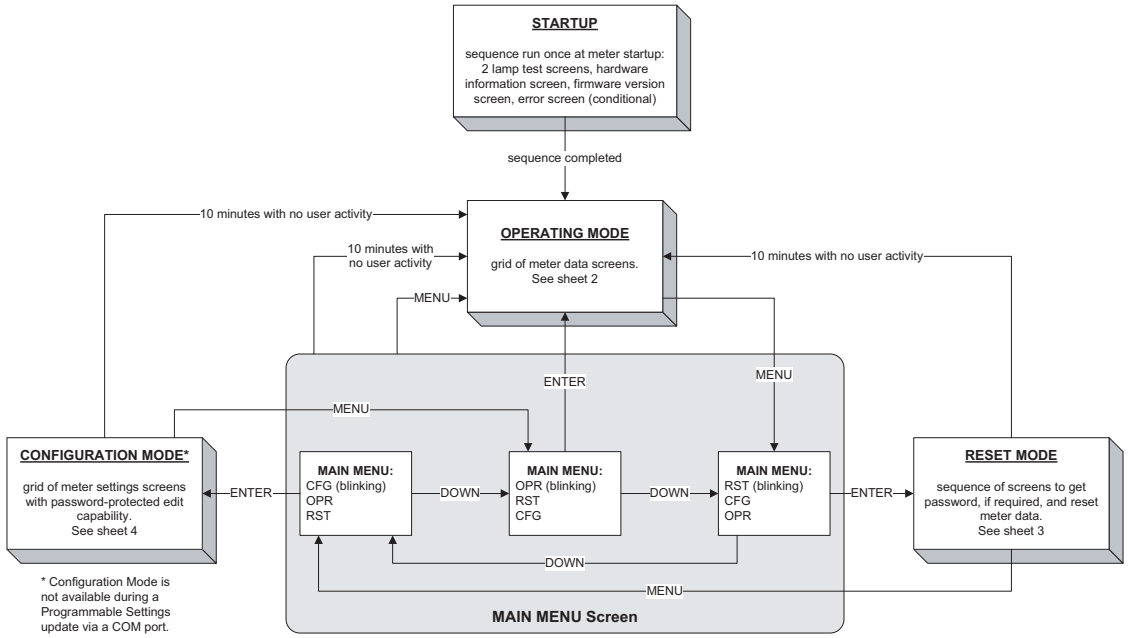
A.2: Navigation Maps (Sheets 1 to 4)

The Shark® 100/50 meter's Navigation maps begin on the next page. The maps show in detail how to move from one screen to another and from one display mode to another using the buttons on the face of the meter. All display modes automatically return to Operating mode after 10 minutes with no user activity.

Shark® 100/50 meter Navigation map titles

- Main Menu Screens (Sheet 1)
- Operating mode screens (Sheet 2)
- Reset mode screens (Sheet 3)
- Configuration mode screens (Sheet 4)

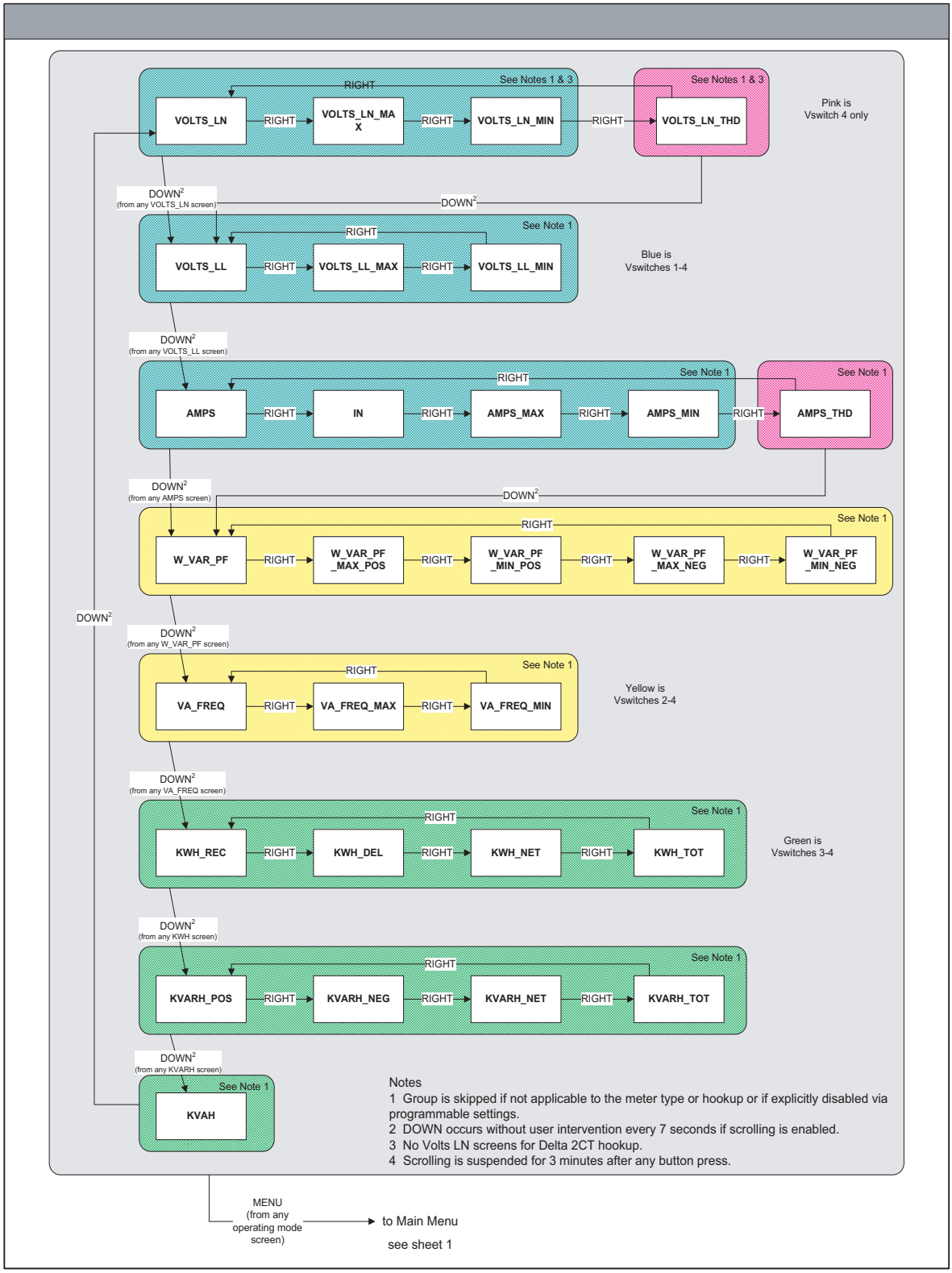
Main Menu Screens (Sheet 1)


STARTUP
sequence run once at meter startup: 2 lamp test screens, hardware information screen, firmware version screen, error screen (conditional)
sequence completed
OPERATING MODE
grid of meter data screens. See sheet 2
10 minutes with no user activity
10 minutes with no user activity
10 minutes with no user activity
MENU
ENTER
MENU
MENU
CONFIGURATION MODE*
grid of meter settings screens with password-protected edit capability. See sheet 4
ENTER
MAIN MENU: CFG (blinking) OPR RST
DOWN
MAIN MENU: OPR (blinking) RST CFG
DOWN
MAIN MENU: RST (blinking) CFG OPR
ENTER
RESET MODE
sequence of screens to get password, if required, and reset meter data. See sheet 3
DOWN
MENU
MAIN MENU Screen
* Configuration Mode is not available during a Programmable Settings update via a COM port.

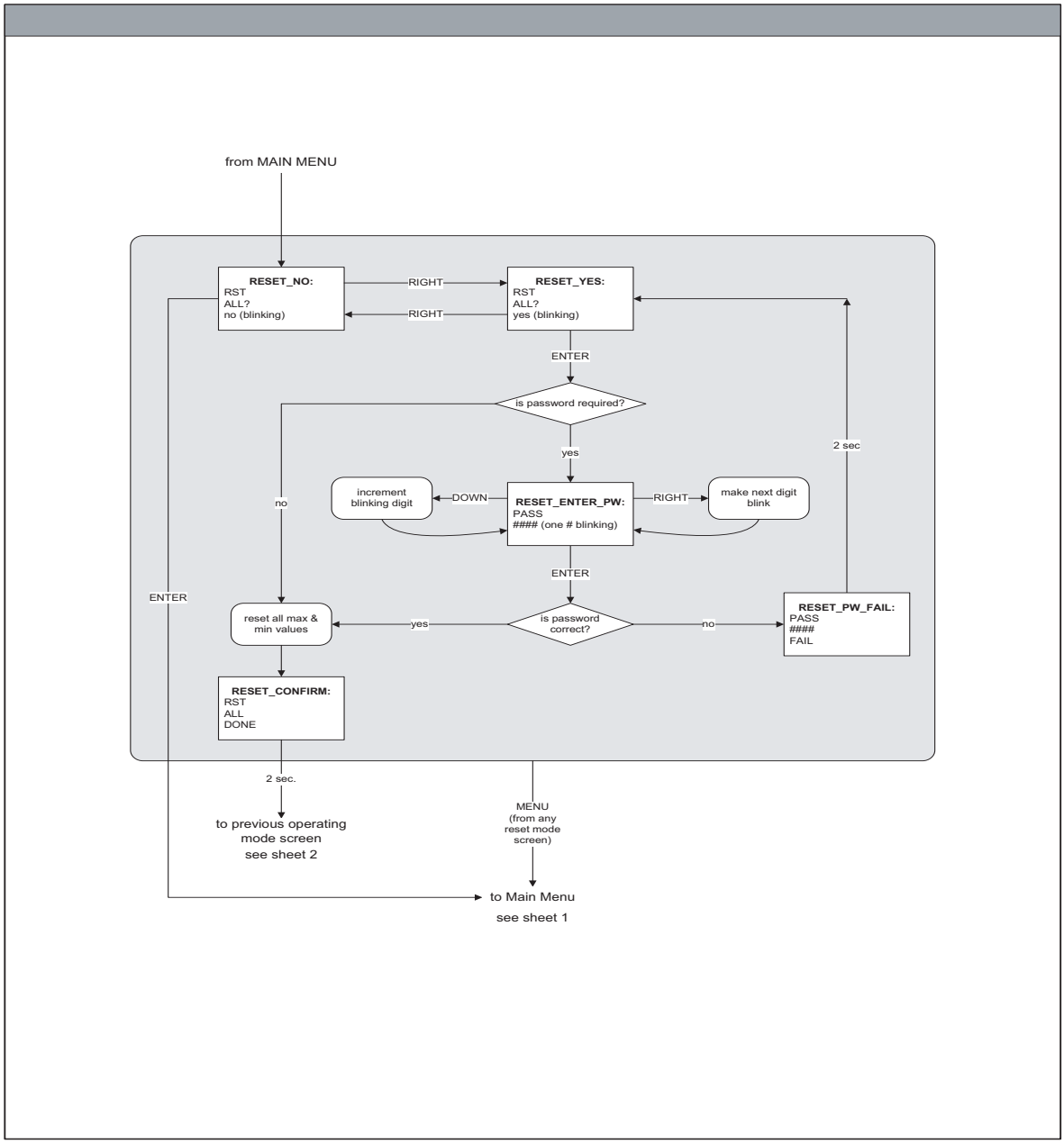
MAIN MENU screen scrolls through 3 choices, showing all 3 at once. The top choice is always the "active" one, which is indicated by blinking the legend.

BUTTONS	
MENU	Returns to previous menu from any screen in any mode
ENTER	Indicates acceptance of the current screen and advances to the next one
DOWN, RIGHT	Navigation and edit buttons
Navigation:	No digits or legends are blinking. On a menu, down advances to the next menu selection, right does nothing. In a grid of screens, down advances to the next row, right advances to the next column. Rows, columns, and menus all navigate circularly.
Editing:	A digit or legend is blinking to indicate that it is eligible for change. When a digit is blinking, down increases the digit value, right moves to the next digit. When a legend is blinking, either button advances to the next choice legend.

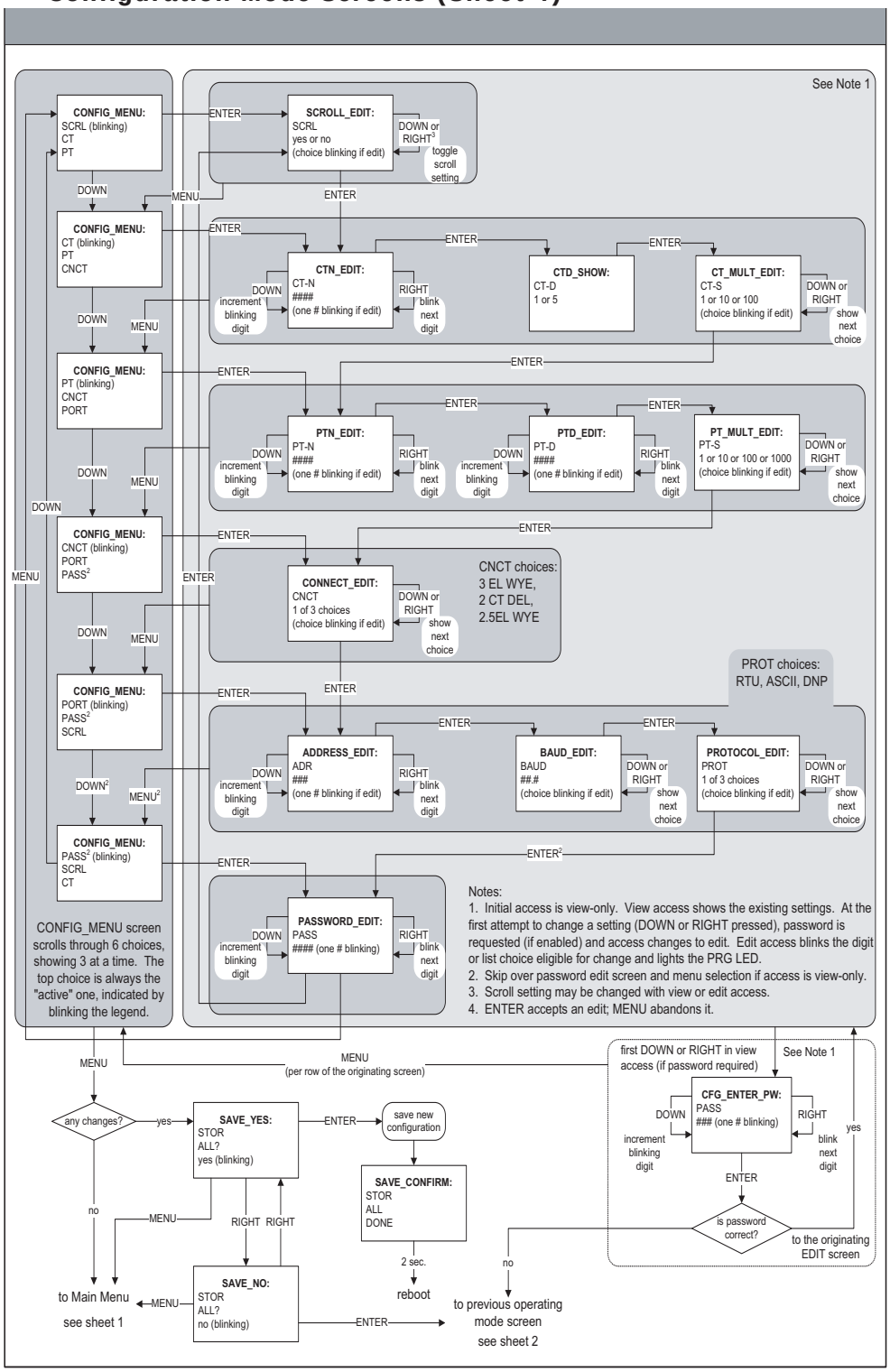
Operating Mode Screens (Sheet 2)



Reset Mode Screens (Sheet 3)



Configuration Mode Screens (Sheet 4)



This page intentionally left blank.

B: Shark® 100 and 50 Meter Modbus Maps

B.1: Introduction

The Modbus maps for the Shark® 100/50 meter gives details and information about the possible readings of the meter and about the programming of the meter. The Shark® 100/50 can be programmed using the buttons on the face plate of the meter (Chapter 6). The meter can also be programmed using software (Chapter 6).

B.2: Modbus Register Map Sections

The Shark® 100/50 Modbus register map includes the following sections:

Fixed Data Section, Registers 1- 47, details the Meter's Fixed Information

Meter Data Section, Registers 1000 - 5003, details the Meter's Readings, including Primary Readings, Energy Block, Demand Block, Maximum and Minimum Blocks, THD Block, Phase Angle Block and Status Block. Operating Mode readings are described in Section 6.2.6

Commands Section, Registers 20000 - 26011, details the Meter's Resets Block, Programming Block, Other Commands Block and Encryption Block

Programmable Settings Section, Registers 30000 - 30067, details the Meter's Basic Setups

Secondary Readings Section, Registers 40001 - 40100, details the Meter's Secondary Readings Setups

B.3: Data Formats

ASCII:	ASCII characters packed 2 per register in high, low order and without any termination characters.
SINT16/UINT16:	16-bit signed/unsigned integer.
SINT32/UINT32:	32-bit signed/unsigned integer spanning 2 registers. The lower-addressed register is the high order half.

FLOAT: 32-bit IEEE floating point number spanning 2 registers. The lower-addressed register is the high order half (i.e., contains the exponent).

B.4: Floating Point Values

Floating Point Values are represented in the following format:

Register	0								1							
Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Meaning	s	e	e	e	e	e	e	e	e	m	m	m	m	m	m	m
	sign	exponent							mantissa							

Register	0								1							
Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Meaning	s	e	e	e	e	e	e	e	e	m	m	m	m	m	m	m
	sign	exponent							mantissa							

The formula to interpret a Floating Point Value is:

$-1^{sign} \times 2^{exponent-127} \times 1.mantissa = 0x0C4E11DB9$

$-1^{sign} \times 2^{137-127} \times 1 \cdot 10000100011110110111001$

$-1 \times 2^{10} \times 1.75871956$

-1800.929

Register	0x0C4E1								0x01DB9							
Byte	0x0C4								0x0E1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	1	1	0	0	0	1	0	0	1	1	1	0	0	0	0	1
Meaning	s	e	e	e	e	e	e	e	e	m	m	m	m	m	m	m
	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
	sign	exponent							mantissa							
	1	0x089 + 137							0b01100001000111101101110011							

Register	0x01DB9								0x0B9v							
Byte	0x01D								0x0B9v							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	0	0	0	1	1	1	0	1	1	0	1	1	1	0	0	1
Meaning																

Formula Explanation:

C4E11DB9 (hex) 11000100 11100001 00011101 10111001 (binary)

The sign of the mantissa (and therefore the number) is 1, which represents a negative value.

The Exponent is 10001001 (binary) or 137 decimal.

The Exponent is a value in excess 127. So, the Exponent value is 10.

The Mantissa is 11000010001110110111001 binary.

With the implied leading 1, the Mantissa is (1).611DB9 (hex).

The Floating Point Representation is therefore -1.75871956 times 2 to the 10.

Decimal equivalent: -1800.929

NOTES:

- Exponent = the whole number before the decimal point.
- Mantissa = the positive fraction after the decimal point.

B.5: Modbus Register Map

The Shark® 100 and 50 meter's Modbus register maps begin on the following page.

This page intentionally left blank.

Shark® 100 Meter Modbus Map

Modbus Address Hex	Modbus Address Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
		Fixed Data Section					
Identification Block						read-only	
0000 - 0007	1 - 8	Meter Name	ASCII	16 char	none		8
0008 - 000F	9 - 16	Meter Serial Number	ASCII	16 char	none		8
0010 - 0010	17 - 17	Meter Type	UINT16	bit-mapped	-------t -----vvv	t = transducer model (1=yes, 0=no), vvv = V-switch(1 to 4)	1
0011 - 0012	18 - 19	Firmware Version	ASCII	4 char	none		2
0013 - 0013	20 - 20	Map Version	UINT16	0 to 65535	none		1
0014 - 0014	21 - 21	Meter Configuration	UINT16	bit-mapped	-------- --ffffff	ffffff = calibration frequency (50 or 60)	1
0015 - 0015	22 - 22	ASIC Version	UINT16	0-65535	none		1
0016 - 0026	23 - 39	Reserved					17
0027 - 002E	40 - 47	Reserved					8
						Block Size:	47
		Meter Data Section [2]					
Primary Readings Block, 6 cycles (IEEE Floating Point						read-only	
0383 - 0384	900 - 901	Watts, 3-Ph total	FLOAT	-9999 M to +9999 M	watts		2
0385 - 0386	902 - 903	VARs, 3-Ph total	FLOAT	-9999 M to +9999 M	VARs		2
0387 - 0388	904 - 905	VAs, 3-Ph total	FLOAT	-9999 M to +9999 M	VAs		2
						Block Size:	6
Primary Readings Block, 60 cycles (IEEE Floating Point)						read-only	
03E7 - 03E8	1000 - 1001	Volts A-N	FLOAT	0 to 9999 M	volts		2
03E9 - 03EA	1002 - 1003	Volts B-N	FLOAT	0 to 9999 M	volts		2
03EB - 03EC	1004 - 1005	Volts C-N	FLOAT	0 to 9999 M	volts		2
03ED - 03EE	1006 - 1007	Volts A-B	FLOAT	0 to 9999 M	volts		2
03EF - 03F0	1008 - 1009	Volts B-C	FLOAT	0 to 9999 M	volts		2
03F1 - 03F2	1010 - 1011	Volts C-A	FLOAT	0 to 9999 M	volts		2
03F3 - 03F4	1012 - 1013	Amps A	FLOAT	0 to 9999 M	amps		2
03F5 - 03F6	1014 - 1015	Amps B	FLOAT	0 to 9999 M	amps		2
03F7 - 03F8	1016 - 1017	Amps C	FLOAT	0 to 9999 M	amps		2
03F9 - 03FA	1018 - 1019	Watts, 3-Ph total	FLOAT	-9999 M to +9999 M	watts		2
03FB - 03FC	1020 - 1021	VARs, 3-Ph total	FLOAT	-9999 M to +9999 M	VARs		2
03FD - 03FE	1022 - 1023	VAs, 3-Ph total	FLOAT	-9999 M to +9999 M	VAs		2
03FF - 0400	1024 - 1025	Power Factor, 3-Ph total	FLOAT	-1.00 to +1.00	none		2
0401 - 0402	1026 - 1027	Frequency	FLOAT	0 to 65.00	Hz		2
0403 - 0404	1028 - 1029	Neutral Current	FLOAT	0 to 9999 M	amps		2
						Block Size:	30

Modbus Address		Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
Hex	Decimal						
Primary Energy Block						read-only	
044B - 044C	1100 - 1101	W-hours, Received	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format	* Wh received & delivered always have opposite signs	2
044D - 044E	1102 - 1103	W-hours, Delivered	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format	* Wh received is positive for "view as load", delivered is positive for "view as generator"	2
044F - 0450	1104 - 1105	W-hours, Net	SINT32	-99999999 to 99999999	Wh per energy format		2
0451 - 0452	1106 - 1107	W-hours, Total	SINT32	0 to 99999999	Wh per energy format	* 5 to 8 digits	2
0453 - 0454	1108 - 1109	VAR-hours, Positive	SINT32	0 to 99999999	VARh per energy format	* decimal point implied, per energy format	2
0455 - 0456	1110 - 1111	VAR-hours, Negative	SINT32	0 to -99999999	VARh per energy format	* resolution of digit before decimal point = units, kilo, or mega, per energy format	2
0457 - 0458	1112 - 1113	VAR-hours, Net	SINT32	-99999999 to 99999999	VARh per energy format		2
0459 - 045A	1114 - 1115	VAR-hours, Total	SINT32	0 to 99999999	VARh per energy format		2
045B - 045C	1116 - 1117	VA-hours, Total	SINT32	0 to 99999999	VAh per energy format	* see note 10	2
						Block Size:	18
Primary Demand Block (IEEE Floating Point)						read-only	
07CF - 07D0	2000 - 2001	Amps A, Average	FLOAT	0 to 9999 M	amps		2
07D1 - 07D2	2002 - 2003	Amps B, Average	FLOAT	0 to 9999 M	amps		2
07D3 - 07D4	2004 - 2005	Amps C, Average	FLOAT	0 to 9999 M	amps		2
07D5 - 07D6	2006 - 2007	Positive Watts, 3-Ph, Average	FLOAT	-9999 M to +9999 M	watts		2
07D7 - 07D8	2008 - 2009	Positive VARs, 3-Ph, Average	FLOAT	-9999 M to +9999 M	VARs		2
07D9 - 07DA	2010 - 2011	Negative Watts, 3-Ph, Average	FLOAT	-9999 M to +9999 M	watts		2
07DB - 07DC	2012 - 2013	Negative VARs, 3-Ph, Average	FLOAT	-9999 M to +9999 M	VARs		2
07DD - 07DE	2014 - 2015	VAs, 3-Ph, Average	FLOAT	-9999 M to +9999 M	VAs		2
07DF - 07E0	2016 - 2017	Positive PF, 3-Ph, Average	FLOAT	-1.00 to +1.00	none		2
07E1 - 07E2	2018 - 2019	Negative PF, 3-PF, Average	FLOAT	-1.00 to +1.00	none		2
						Block Size:	20
Primary Minimum Block (IEEE Floating Point)						read-only	
0BB7 - 0BB8	3000 - 3001	Volts A-N, Minimum	FLOAT	0 to 9999 M	volts		2
0BB9 - 0BBA	3002 - 3003	Volts B-N, Minimum	FLOAT	0 to 9999 M	volts		2
0BBB - 0BBC	3004 - 3005	Volts C-N, Minimum	FLOAT	0 to 9999 M	volts		2
0BBD - 0BBE	3006 - 3007	Volts A-B, Minimum	FLOAT	0 to 9999 M	volts		2
0BBF - 0BC0	3008 - 3009	Volts B-C, Minimum	FLOAT	0 to 9999 M	volts		2
0BC1 - 0BC2	3010 - 3011	Volts C-A, Minimum	FLOAT	0 to 9999 M	volts		2
0BC3 - 0BC4	3012 - 3013	Amps A, Minimum Avg Demand	FLOAT	0 to 9999 M	amps		2
0BC5 - 0BC6	3014 - 3015	Amps B, Minimum Avg Demand	FLOAT	0 to 9999 M	amps		2
0BC7 - 0BC8	3016 - 3017	Amps C, Minimum Avg Demand	FLOAT	0 to 9999 M	amps		2
0BC9 - 0BCA	3018 - 3019	Positive Watts, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	watts		2
0BCB - 0BCC	3020 - 3021	Positive VARs, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	VARs		2
0BCD - 0BCE	3022 - 3023	Negative Watts, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	watts		2
0BCF - 0BD0	3024 - 3025	Negative VARs, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	VARs		2
0BD1 - 0BD2	3026 - 3027	VAs, 3-Ph, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
0BD3 - 0BD4	3028 - 3029	Positive Power Factor, 3-Ph, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2

Modbus Address							
Hex	Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
0BD5 - 0BD6	3030 - 3031	Negative Power Factor, 3-Ph, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2
0BD7 - 0BD8	3032 - 3033	Frequency, Minimum	FLOAT	0 to 65.00	Hz		2
						Block Size:	34
Primary Maximum Block (IEEE Floating Point)						read-only	
0C1B - 0C1C	3100 - 3101	Volts A-N, Maximum	FLOAT	0 to 9999 M	volts		2
0C1D - 0C1E	3102 - 3103	Volts B-N, Maximum	FLOAT	0 to 9999 M	volts		2
0C1F - 0C20	3104 - 3105	Volts C-N, Maximum	FLOAT	0 to 9999 M	volts		2
0C21 - 0C22	3106 - 3107	Volts A-B, Maximum	FLOAT	0 to 9999 M	volts		2
0C23 - 0C24	3108 - 3109	Volts B-C, Maximum	FLOAT	0 to 9999 M	volts		2
0C25 - 0C26	3110 - 3111	Volts C-A, Maximum	FLOAT	0 to 9999 M	volts		2
0C27 - 0C28	3112 - 3113	Amps A, Maximum Avg Demand	FLOAT	0 to 9999 M	amps		2
0C29 - 0C2A	3114 - 3115	Amps B, Maximum Avg Demand	FLOAT	0 to 9999 M	amps		2
0C2B - 0C2C	3116 - 3117	Amps C, Maximum Avg Demand	FLOAT	0 to 9999 M	amps		2
0C2D - 0C2E	3118 - 3119	Positive Watts, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	watts		2
0C2F - 0C30	3120 - 3121	Positive VARs, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	VARs		2
0C31 - 0C32	3122 - 3123	Negative Watts, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	watts		2
0C33 - 0C34	3124 - 3125	Negative VARs, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	VARs		2
0C35 - 0C36	3126 - 3127	VAs, 3-Ph, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
0C37 - 0C38	3128 - 3129	Positive Power Factor, 3-Ph, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
0C39 - 0C3A	3130 - 3131	Negative Power Factor, 3-Ph, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
0C3B - 0C3C	3132 - 3133	Frequency, Maximum	FLOAT	0 to 65.00	Hz		2
						Block Size:	34
THD Block[7, 13]						read-only	
0F9F - 0F9F	4000 - 4000	Volts A-N, %THD	UINT16	0 to 9999, or 65535	0.1%		1
0FA0 - 0FA0	4001 - 4001	Volts B-N, %THD	UINT16	0 to 9999, or 65535	0.1%		1
0FA1 - 0FA1	4002 - 4002	Volts C-N, %THD	UINT16	0 to 9999, or 65535	0.1%		1
0FA2 - 0FA2	4003 - 4003	Amps A, %THD	UINT16	0 to 9999, or 65535	0.1%		1
0FA3 - 0FA3	4004 - 4004	Amps B, %THD	UINT16	0 to 9999, or 65535	0.1%		1
0FA4 - 0FA4	4005 - 4005	Amps C, %THD	UINT16	0 to 9999, or 65535	0.1%		1
0FA5 - 0FA5	4006 - 4006	Phase A Current 1st harmonic magnitude	UINT16	0 to 65535	none		1
0FA6 - 0FA6	4007 - 4007	Phase A Current 2nd harmonic magnitude	UINT16	0 to 65535	none		1
0FA7 - 0FA7	4008 - 4008	Phase A Current 3rd harmonic magnitude	UINT16	0 to 65535	none		1
0FA8 - 0FA8	4009 - 4009	Phase A Current 4th harmonic magnitude	UINT16	0 to 65535	none		1
0FA9 - 0FA9	4010 - 4010	Phase A Current 5th harmonic magnitude	UINT16	0 to 65535	none		1
0FAA - 0FAA	4011 - 4011	Phase A Current 6th harmonic magnitude	UINT16	0 to 65535	none		1
0FAB - 0FAB	4012 - 4012	Phase A Current 7th harmonic magnitude	UINT16	0 to 65535	none		1
0FAC - 0FAC	4013 - 4013	Phase A Current 8th harmonic magnitude	UINT16	0 to 65535	none		1
0FAD - 0FAD	4014 - 4014	Phase A Voltage 1st harmonic magnitude	UINT16	0 to 65535	none		1
0FAE - 0FAE	4015 - 4015	Phase A Voltage 2nd harmonic magnitude	UINT16	0 to 65535	none		1
0FAF - 0FAF	4016 - 4016	Phase A Voltage 3rd harmonic magnitude	UINT16	0 to 65535	none		1
0FB0 - 0FB0	4017 - 4017	Phase A Voltage 4th harmonic magnitude	UINT16	0 to 65535	none		1
0FB1 - 0FB8	4018 - 4025	Phase B Current harmonic magnitudes	same as Phase A Current 1st to 8th harmonic magnitudes				8
0FB9 - 0FBC	4026 - 4029	Phase B Voltage harmonic magnitudes	same as Phase A Voltage 1st to 8th harmonic magnitudes				4
0FBD - 0FC4	4030 - 4037	Phase C Current harmonic magnitudes	same as Phase A Current 1st to 8th harmonic magnitudes				8
0FC5 - 0FC8	4038 - 4041	Phase C Voltage harmonic magnitudes	same as Phase A Voltage 1st to 8th harmonic magnitudes				4
						Block Size:	42

Modbus Address Hex	Modbus Address Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
Phase Angle Block[14]						read-only	
1003 - 1003	4100 - 4100	Phase A Current	SINT16	-1800 to +1800	0.1 degree		1
1004 - 1004	4101 - 4101	Phase B Current	SINT16	-1800 to +1800	0.1 degree		1
1005 - 1005	4102 - 4102	Phase C Current	SINT16	-1800 to +1800	0.1 degree		1
1006 - 1006	4103 - 4103	Angle, Volts A-B	SINT16	-1800 to +1800	0.1 degree		1
1007 - 1007	4104 - 4104	Angle, Volts B-C	SINT16	-1800 to +1800	0.1 degree		1
1008 - 1008	4105 - 4105	Angle, Volts C-A	SINT16	-1800 to +1800	0.1 degree		1
						Block Size:	6
Status Block						read-only	
1387 - 1387	5000 - 5000	Meter Status	UINT16	bit-mapped	--exnpch ssssssss	exnpch = EEPROM block OK flags (e=energy, x=max, n=min, p=programmable settings, c=calibration, h=header), ssssssss = state (1=Run, 2=Limp, 10=Prog Set Update via buttons, 11=Prog Set Update via IrDA, 12=Prog Set Update via COM2)	1
1388 - 1388	5001 - 5001	Limits Status[7]	UINT16	bit-mapped	87654321 87654321	high byte is setpt 1, 0=in, 1=out low byte is setpt 2, 0=in, 1=out	1
1389 - 138A	5002 - 5003	Time Since Reset	UINT32	0 to 4294967294	4 msec	wraps around after max count	2
						Block Size:	4
Commands Section[4]							
Resets Block[9]						write-only	
4E1F - 4E1F	20000 - 20000	Reset Max/Min Blocks	UINT16	password[5]			1
4E20 - 4E20	20001 - 20001	Reset Energy Accumulators	UINT16	password[5]			1
						Block Size:	2
Meter Programming Block						read/conditional write	
55EF - 55EF	22000 - 22000	Initiate Programmable Settings Update	UINT16	password[5]		meter enters PS update mode	1
55F0 - 55F0	22001 - 22001	Terminate Programmable Settings Update[3]	UINT16	any value		meter leaves PS update mode via reset	1
55F1 - 55F1	22002 - 22002	Calculate Programmable Settings Checksum[3]	UINT16			meter calculates checksum on RAM copy of PS block	1
55F2 - 55F2	22003 - 22003	Programmable Settings Checksum[3]	UINT16			read/write checksum register; PS block saved in EEPROM on write[8]	1
55F3 - 55F3	22004 - 22004	Write New Password[3]	UINT16	0000 to 9999		write-only register; always reads zero	1
59D7 - 59D7	23000 - 23000	Initiate Meter Firmware Reprogramming	UINT16	password[5]			1
						Block Size:	6

Modbus Address Hex	Modbus Address Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
Other Commands Block						read/write	
61A7 - 61A7	25000 - 25000	Force Meter Restart	UINT16	password[5]		causes a watchdog reset, always reads 0	1
						Block Size:	1
Encryption Block						read/write	
658F - 659A	26000 - 26011	Perform a Secure Operation	UINT16			encrypted command to read password or change meter type	12
						Block Size:	12
Programmable Settings Section							
Basic Setups Block						write only in PS update mode	
752F - 752F	30000 - 30000	CT multiplier & denominator	UINT16	bit-mapped	dddddddd mmmmmmmm	high byte is denominator (1 or 5, read-only), low byte is multiplier (1, 10, or 100)	1
7530 - 7530	30001 - 30001	CT numerator	UINT16	1 to 9999	none		1
7531 - 7531	30002 - 30002	PT numerator	UINT16	1 to 9999	none		1
7532 - 7532	30003 - 30003	PT denominator	UINT16	1 to 9999	none		1
7533 - 7533	30004 - 30004	PT multiplier & hookup	UINT16	bit-mapped	mmmmmmmm MMMMhhhh	MMMMmmmmmmmm is PT multiplier (1, 10, 100, 1000), hhhh is hookup enumeration (0 = 3 element wye[9S], 1 = delta 2 CTs[5S], 3 = 2.5 element wye[6S])	1
7534 - 7534	30005 - 30005	Averaging Method	UINT16	bit-mapped	--iiiiii b----sss	iiiii = interval (5,15,30,60) b = 0-block or 1-rolling sss = # subintervals (1,2,3,4)	1
7535 - 7535	30006 - 30006	Power & Energy Format	UINT16	bit-mapped	pppp--nn -eee-ddd	pppp = power scale (0-unit, 3-kilo, 6-mega, 8-auto) nn = number of energy digits (5-8 --> 0-3) eee = energy scale (0-unit, 3-kilo, 6-mega) ddd = energy digits after decimal point (0-6) See note 10.	1
7536 - 7536	30007 - 30007	Operating Mode Screen Enables	UINT16	bit-mapped	00000000 eeeeeeee	eeeeeeee = op mode screen rows on(1) or off(0), rows top to bottom are bits low order to high order	1
7537 - 753D	30008 - 30014	Reserved					7

Modbus Address		Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
Hex	Decimal						
753E - 753E	30015 - 30015	User Settings Flags	UINT16	bit-mapped	---g--nn srp--wf-	g = enable alternate full scale bargraph current (1=on, 0=off) nn = number of phases for voltage & current screens (3=ABC, 2=AB, 1=A, 0=ABC) s = scroll (1=on, 0=off) r = password for reset in use (1=on, 0=off) p = password for configuration in use (1=on, 0=off) w = pwr dir (0-view as load, 1-view as generator) f = flip power factor sign (1=yes, 0=no)	1
753F - 753F	30016 - 30016	Full Scale Current (for load % bargraph)	UINT16	0 to 9999	none	If non-zero and user settings bit g is set, this value replaces CT numerator in the full scale current calculation.	1
7540 - 7547	30017 - 30024	Meter Designation	ASCII	16 char	none		8
7548 - 7548	30025 - 30025	COM1 setup	UINT16	bit-mapped	----dddd -0100110	dddd = reply delay (* 50 msec) ppp = protocol (1-Modbus RTU, 2-Modbus ASCII, 3-DNP) bbb = baud rate (1-9600, 2-19200, 4-38400, 6-57600)	1
7549 - 7549	30026 - 30026	COM2 setup	UINT16	bit-mapped	----dddd -ppp-bbb		1
754A - 754A	30027 - 30027	COM2 address	UINT16	1 to 247	none		1
754B - 754B	30028 - 30028	Limit #1 Identifier	UINT16	0 to 65535		use Modbus address as the identifier (see notes 7, 11, 12)	1
754C - 754C	30029 - 30029	Limit #1 Out High Setpoint	SINT16	-200.0 to +200.0	0.1% of full scale	Setpoint for the "above" limit (LM1), see notes 11-12.	1
754D - 754D	30030 - 30030	Limit #1 In High Threshold	SINT16	-200.0 to +200.0	0.1% of full scale	Threshold at which "above" limit clears; normally less than or equal to the "above" setpoint; see notes 11-12.	1
754E - 754E	30031 - 30031	Limit #1 Out Low Setpoint	SINT16	-200.0 to +200.0	0.1% of full scale	Setpoint for the "below" limit (LM2), see notes 11-12.	1
754F - 754F	30032 - 30032	Limit #1 In Low Threshold	SINT16	-200.0 to +200.0	0.1% of full scale	Threshold at which "below" limit clears; normally greater than or equal to the "below" setpoint; see notes 11-12.	1
7550 - 7554	30033 - 30037	Limit #2	SINT16	same as Limit #1	same as Limit #1	same as Limit #1	5
7555 - 7559	30038 - 30042	Limit #3	SINT16				5
755A - 755E	30043 - 30047	Limit #4	SINT16				5
755F - 7563	30048 - 30052	Limit #5	SINT16				5
7564 - 7568	30053 - 30057	Limit #6	SINT16				5
7569 - 756D	30058 - 30062	Limit #7	SINT16				5
756E - 7572	30063 - 30067	Limit #8	SINT16				5
						Block Size:	68

Modbus Address Hex	Modbus Address Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
12-Bit Readings Section							
12-Bit Block						read-only except as noted	
9C40 - 9C40	40001 - 40001	System Sanity Indicator	UINT16	0 or 1	none	0 indicates proper meter operation	1
9C41 - 9C41	40002 - 40002	Volts A-N	UINT16	2047 to 4095	volts	2047= 0, 4095= +150	1
9C42 - 9C42	40003 - 40003	Volts B-N	UINT16	2047 to 4095	volts	volts = 150 * (register - 2047) / 2047	1
9C43 - 9C43	40004 - 40004	Volts C-N	UINT16	2047 to 4095	volts		1
9C44 - 9C44	40005 - 40005	Amps A	UINT16	0 to 4095	amps	0= -10, 2047= 0, 4095= +10	1
9C45 - 9C45	40006 - 40006	Amps B	UINT16	0 to 4095	amps	amps = 10 * (register - 2047) / 2047	1
9C46 - 9C46	40007 - 40007	Amps C	UINT16	0 to 4095	amps		1
9C47 - 9C47	40008 - 40008	Watts, 3-Ph total	UINT16	0 to 4095	watts	0= -3000, 2047= 0, 4095= +3000	1
9C48 - 9C48	40009 - 40009	VARs, 3-Ph total	UINT16	0 to 4095	VARs	watts, VARs, VAs =	1
9C49 - 9C49	40010 - 40010	VAs, 3-Ph total	UINT16	2047 to 4095	VAs	3000 * (register - 2047) / 2047	1
9C4A - 9C4A	40011 - 40011	Power Factor, 3-Ph total	UINT16	1047 to 3047	none	1047= -1, 2047= 0, 3047= +1 pf = (register - 2047) / 1000	1
9C4B - 9C4B	40012 - 40012	Frequency	UINT16	0 to 2730	Hz	0= 45 or less, 2047= 60, 2730= 65 or more freq = 45 + ((register / 4095) * 30)	1
9C4C - 9C4C	40013 - 40013	Volts A-B	UINT16	2047 to 4095	volts	2047= 0, 4095= +300	1
9C4D - 9C4D	40014 - 40014	Volts B-C	UINT16	2047 to 4095	volts	volts = 300 * (register - 2047) / 2047	1
9C4E - 9C4E	40015 - 40015	Volts C-A	UINT16	2047 to 4095	volts		1
9C4F - 9C4F	40016 - 40016	CT numerator	UINT16	1 to 9999	none		1
9C50 - 9C50	40017 - 40017	CT multiplier	UINT16	1, 10, 100	none	CT = numerator * multiplier / denominator	1
9C51 - 9C51	40018 - 40018	CT denominator	UINT16	1 or 5	none		1
9C52 - 9C52	40019 - 40019	PT numerator	UINT16	1 to 9999	none		1
9C53 - 9C53	40020 - 40020	PT multiplier	UINT16	1, 10, 100	none	PT = numerator * multiplier / denominator	1
9C54 - 9C54	40021 - 40021	PT denominator	UINT16	1 to 9999	none		1
9C55 - 9C56	40022 - 40023	W-hours, Positive	UINT32	0 to 99999999	Wh per energy format	* 5 to 8 digits	2
9C57 - 9C58	40024 - 40025	W-hours, Negative	UINT32	0 to 99999999	Wh per energy format	* decimal point implied, per energy format	2
9C59 - 9C5A	40026 - 40027	VAR-hours, Positive	UINT32	0 to 99999999	VARh per energy format	* resolution of digit before decimal point =	2
9C5B - 9C5C	40028 - 40029	VAR-hours, Negative	UINT32	0 to 99999999	VARh per energy format	units, kilo, or mega, per energy format	2
9C5D - 9C5E	40030 - 40031	VA-hours	UINT32	0 to 99999999	VAh per energy format	* see note 10	2
9C5F - 9C5F	40032 - 40032	Neutral Current	UINT16	0 to 4095	amps	see Amps A/B/C above	1
9C60 - 9CA2	40033 - 40099	Reserved	N/A	N/A	none		67
9CA3 - 9CA3	40100 - 40100	Reset Energy Accumulators	UINT16	password[5]		write-only register; always reads as 0	1
						Block Size:	100

End of Map

Data Formats	
ASCII	ASCII characters packed 2 per register in high, low order and without any termination characters. For example, "Shark100" would be 4 registers containing 0x5378, 0x6172, 0x6B31, 0x3030.
SINT16 / UINT16	16-bit signed / unsigned integer.

Notes	
1	All registers not explicitly listed in the table read as 0. Writes to these registers will be accepted but won't actually change the register (since it doesn't exist).
2	Meter Data Section items read as 0 until first readings are available or if the meter is not in operating mode. Writes to these registers will be accepted but won't actually change the register.
3	Register valid only in programmable settings update mode. In other modes these registers read as 0 and return an illegal data address exception if a write is attempted.
4	Meter command registers always read as 0. They may be written only when the meter is in a suitable mode. The registers return an illegal data address exception if a write is attempted in an incorrect mode.
5	If the password is incorrect, a valid response is returned but the command is not executed. Use 5555 for the password if passwords are disabled in the programmable settings.
6	M denotes a 1,000,000 multiplier.
7	Not applicable to Shark 100, V-Switch 1, 2, or 3
8	Writing this register causes data to be saved permanently in EEPROM. If there is an error while saving, a slave device failure exception is returned and programmable settings mode automatically terminates via reset.
9	Reset commands make no sense if the meter state is LIMP. An illegal function exception will be returned.
10	Energy registers should be reset after a format change.
11	Entities to be monitored against limits are identified by Modbus address. Entities occupying multiple Modbus registers, such as floating point values, are identified by the lower register address. If any of the 8 limits is unused, set its identifier to zero. If the indicated Modbus register is not used or is a non-sensical entity for limits, it will behave as an unused limit.
12	There are 2 setpoints per limit, one above and one below the expected range of values. LM1 is the "too high" limit, LM2 is "too low". The entity goes "out of limit" on LM1 when its value is greater than the setpoint. It remains "out of limit" until the value drops below the in threshold. LM2 works similarly, in the opposite direction. If limits in only one direction are of interest, set the in threshold on the "wrong" side of the setpoint. Limits are specified as % of full scale, where full scale is automatically set appropriately for the entity being monitored:

current	FS = CT numerator * CT multiplier
voltage	FS = PT numerator * PT multiplier
power	FS = CT numerator * CT multiplier * PT numerator * PT multiplier * 3 [* SQRT(3) for delta hookup]
frequency	FS = 60 (or 50)
power factor	FS = 1.0
percentage	FS = 100.0
angle	FS = 180.0

13	THD not available shows 65535 (=0xFFFF) in all THD and harmonic magnitude registers for the channel when V-switch=4. THD may be unavailable due to low V or I amplitude, or delta hookup (V only).
14	All 3 voltage angles are measured for Wye and Delta hookups. For 2.5 Element, Vac is measured and Vab & Vbc are calculated. If a voltage phase is missing, the two voltage angles in which it participates are set to zero. A and C phase current angles are measured for all hookups. B phase current angle is measured for Wye and is zero for other hookups. If a voltage phase is missing, its current angle is zero.
15	If any register in the programmable settings section is set to a value other than the acceptable value, the meter will stay in LIMP mode. Please read the comment section or the rangle for each register the programmable settings section for acceptable values.
16	If V-Switch is 1 or 2 and protocol (ppp) is set to "3" (DNP), the meter will use the Modbus RTU protocol as DNP is supported by v-Switch 3 and above.

Shark® 50 Meter Modbus Map

Modbus Address							
Hex	Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
Fixed Data Section							
Identification Block						read-only	
0000 - 0007	1 - 8	Meter Name	ASCII	16 char	none		8
0008 - 000F	9 - 16	Meter Serial Number	ASCII	16 char	none		8
0010 - 0010	17 - 17	Meter Type	UINT16	bit-mapped	-------t -----vvv	t = 0 vvv = V-switch(1 to 3)	1
0011 - 0012	18 - 19	Firmware Version	ASCII	4 char	none		2
0013 - 0013	20 - 20	Map Version	UINT16	0 to 65535	none		1
0014 - 0014	21 - 21	Meter Configuration	UINT16	bit-mapped	-------- --ffffff	ffffff = calibration frequency (50 or 60)	1
0015 - 0015	22 - 22	ASIC Version	UINT16	0-65535	none		1
0016 - 0026	23 - 39	Reserved - do not use.					17
0027 - 002E	40 - 47	Reserved - do not use.					8
						Block Size:	47
Meter Data Section [2]							
Primary Readings Block, 6 cycles (IEEE Floating Point)						read-only	
0383 - 0384	900 - 901	Watts, 3-Ph total	FLOAT	-9999 M to +9999 M	watts		2
0385 - 0386	902 - 903	VARs, 3-Ph total	FLOAT	-9999 M to +9999 M	VARs		2
0387 - 0388	904 - 905	VAs, 3-Ph total	FLOAT	-9999 M to +9999 M	VAs		2
						Block Size:	6
Primary Readings Block, 60 cycles (IEEE Floating Point)						read-only	
03E7 - 03E8	1000 - 1001	Volts A-N	FLOAT	0 to 9999 M	volts		2
03E9 - 03EA	1002 - 1003	Volts B-N	FLOAT	0 to 9999 M	volts		2
03EB - 03EC	1004 - 1005	Volts C-N	FLOAT	0 to 9999 M	volts		2
03ED - 03EE	1006 - 1007	Volts A-B	FLOAT	0 to 9999 M	volts		2
03EF - 03F0	1008 - 1009	Volts B-C	FLOAT	0 to 9999 M	volts		2
03F1 - 03F2	1010 - 1011	Volts C-A	FLOAT	0 to 9999 M	volts		2
03F3 - 03F4	1012 - 1013	Amps A	FLOAT	0 to 9999 M	amps		2
03F5 - 03F6	1014 - 1015	Amps B	FLOAT	0 to 9999 M	amps		2
03F7 - 03F8	1016 - 1017	Amps C	FLOAT	0 to 9999 M	amps		2
03F9 - 03FA	1018 - 1019	Watts, 3-Ph total	FLOAT	-9999 M to +9999 M	watts		2
03FB - 03FC	1020 - 1021	VARs, 3-Ph total	FLOAT	-9999 M to +9999 M	VARs		2
03FD - 03FE	1022 - 1023	VAs, 3-Ph total	FLOAT	-9999 M to +9999 M	VAs		2
03FF - 0400	1024 - 1025	Power Factor, 3-Ph total	FLOAT	-1.00 to +1.00	none		2
0401 - 0402	1026 - 1027	Frequency	FLOAT	0 to 65.00	Hz		2

Modbus Address							
Hex	Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
0403 - 0404	1028 - 1029	Neutral Current	FLOAT	0 to 9999 M	amps		2
						Block Size:	30
Primary Energy Block						read-only	
044B - 044C	1100 - 1101	W-hours, Received	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format	* Wh received & delivered always have opposite signs	2
044D - 044E	1102 - 1103	W-hours, Delivered	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format	* Wh received is positive for "view as load", delivered is positive for "view as generator"	2
044F - 0450	1104 - 1105	W-hours, Net	SINT32	-99999999 to 99999999	Wh per energy format		2
0451 - 0452	1106 - 1107	W-hours, Total	SINT32	0 to 99999999	Wh per energy format	* 5 to 8 digits	2
0453 - 0454	1108 - 1109	VAR-hours, Positive	SINT32	0 to 99999999	VARh per energy format	* decimal point implied, per energy format	2
0455 - 0456	1110 - 1111	VAR-hours, Negative	SINT32	0 to -99999999	VARh per energy format	* resolution of digit before decimal point =	2
0457 - 0458	1112 - 1113	VAR-hours, Net	SINT32	-99999999 to 99999999	VARh per energy format	units, kilo, or mega, per energy format	2
0459 - 045A	1114 - 1115	VAR-hours, Total	SINT32	0 to 99999999	VARh per energy format		2
045B - 045C	1116 - 1117	VA-hours, Total	SINT32	0 to 99999999	VAh per energy format	* see note 10	2
						Block Size:	18
Primary Demand Block (IEEE Floating Point)						read-only	
07CF - 07D0	2000 - 2001	Amps A, Average	FLOAT	0 to 9999 M	amps		2
07D1 - 07D2	2002 - 2003	Amps B, Average	FLOAT	0 to 9999 M	amps		2
07D3 - 07D4	2004 - 2005	Amps C, Average	FLOAT	0 to 9999 M	amps		2
07D5 - 07D6	2006 - 2007	Positive Watts, 3-Ph, Average	FLOAT	-9999 M to +9999 M	watts		2
07D7 - 07D8	2008 - 2009	Positive VARs, 3-Ph, Average	FLOAT	-9999 M to +9999 M	VARs		2
07D9 - 07DA	2010 - 2011	Negative Watts, 3-Ph, Average	FLOAT	-9999 M to +9999 M	watts		2
07DB - 07DC	2012 - 2013	Negative VARs, 3-Ph, Average	FLOAT	-9999 M to +9999 M	VARs		2
07DD - 07DE	2014 - 2015	VAs, 3-Ph, Average	FLOAT	-9999 M to +9999 M	VAs		2
07DF - 07E0	2016 - 2017	Positive PF, 3-Ph, Average	FLOAT	-1.00 to +1.00	none		2
07E1 - 07E2	2018 - 2019	Negative PF, 3-PF, Average	FLOAT	-1.00 to +1.00	none		2
						Block Size:	20
Primary Minimum Block (IEEE Floating Point)						read-only	
0BB7 - 0BB8	3000 - 3001	Volts A-N, Minimum	FLOAT	0 to 9999 M	volts		2
0BB9 - 0BBA	3002 - 3003	Volts B-N, Minimum	FLOAT	0 to 9999 M	volts		2
0BBB - 0BBC	3004 - 3005	Volts C-N, Minimum	FLOAT	0 to 9999 M	volts		2
0BBD - 0BBE	3006 - 3007	Volts A-B, Minimum	FLOAT	0 to 9999 M	volts		2
0BBF - 0BC0	3008 - 3009	Volts B-C, Minimum	FLOAT	0 to 9999 M	volts		2
0BC1 - 0BC2	3010 - 3011	Volts C-A, Minimum	FLOAT	0 to 9999 M	volts		2
0BC3 - 0BC4	3012 - 3013	Amps A, Minimum Avg Demand	FLOAT	0 to 9999 M	amps		2
0BC5 - 0BC6	3014 - 3015	Amps B, Minimum Avg Demand	FLOAT	0 to 9999 M	amps		2
0BC7 - 0BC8	3016 - 3017	Amps C, Minimum Avg Demand	FLOAT	0 to 9999 M	amps		2

Modbus Address							
Hex	Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
0BC9 - 0BCA	3018 - 3019	Positive Watts, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	watts		2
0BCB - 0BCC	3020 - 3021	Positive VARs, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	VARs		2
0BCD - 0BCE	3022 - 3023	Negative Watts, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	watts		2
0BCF - 0BD0	3024 - 3025	Negative VARs, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	VARs		2
0BD1 - 0BD2	3026 - 3027	VAs, 3-Ph, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
0BD3 - 0BD4	3028 - 3029	Positive Power Factor, 3-Ph, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2
0BD5 - 0BD6	3030 - 3031	Negative Power Factor, 3-Ph, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2
0BD7 - 0BD8	3032 - 3033	Frequency, Minimum	FLOAT	0 to 65.00	Hz		2
						Block Size:	34
Primary Maximum Block (IEEE Floating Point)						read-only	
0C1B - 0C1C	3100 - 3101	Volts A-N, Maximum	FLOAT	0 to 9999 M	volts		2
0C1D - 0C1E	3102 - 3103	Volts B-N, Maximum	FLOAT	0 to 9999 M	volts		2
0C1F - 0C20	3104 - 3105	Volts C-N, Maximum	FLOAT	0 to 9999 M	volts		2
0C21 - 0C22	3106 - 3107	Volts A-B, Maximum	FLOAT	0 to 9999 M	volts		2
0C23 - 0C24	3108 - 3109	Volts B-C, Maximum	FLOAT	0 to 9999 M	volts		2
0C25 - 0C26	3110 - 3111	Volts C-A, Maximum	FLOAT	0 to 9999 M	volts		2
0C27 - 0C28	3112 - 3113	Amps A, Maximum Avg Demand	FLOAT	0 to 9999 M	amps		2
0C29 - 0C2A	3114 - 3115	Amps B, Maximum Avg Demand	FLOAT	0 to 9999 M	amps		2
0C2B - 0C2C	3116 - 3117	Amps C, Maximum Avg Demand	FLOAT	0 to 9999 M	amps		2
0C2D - 0C2E	3118 - 3119	Positive Watts, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	watts		2
0C2F - 0C30	3120 - 3121	Positive VARs, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	VARs		2
0C31 - 0C32	3122 - 3123	Negative Watts, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	watts		2
0C33 - 0C34	3124 - 3125	Negative VARs, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	VARs		2
0C35 - 0C36	3126 - 3127	VAs, 3-Ph, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
0C37 - 0C38	3128 - 3129	Positive Power Factor, 3-Ph, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
0C39 - 0C3A	3130 - 3131	Negative Power Factor, 3-Ph, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
0C3B - 0C3C	3132 - 3133	Frequency, Maximum	FLOAT	0 to 65.00	Hz		2
						Block Size:	34
Phase Angle Block[14]						read-only	
1003 - 1003	4100 - 4100	Phase A Current	SINT16	-1800 to +1800	0.1 degree		1
1004 - 1004	4101 - 4101	Phase B Current	SINT16	-1800 to +1800	0.1 degree		1
1005 - 1005	4102 - 4102	Phase C Current	SINT16	-1800 to +1800	0.1 degree		1
1006 - 1006	4103 - 4103	Angle, Volts A-B	SINT16	-1800 to +1800	0.1 degree		1
1007 - 1007	4104 - 4104	Angle, Volts B-C	SINT16	-1800 to +1800	0.1 degree		1

Modbus Address							
Hex	Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
1008 - 1008	4105 - 4105	Angle, Volts C-A	SINT16	-1800 to +1800	0.1 degree		1
						Block Size:	6
Status Block						read-only	
1387 - 1387	5000 - 5000	Meter Status	UINT16	bit-mapped	--exnpch ssssssss	exnpch = EEPROM block OK flags (e=energy, x=max, n=min, p=programmable settings, c=calibration, h=header), ssssssss = state (1=Run, 2=Limp, 10=Prog Set Update via buttons, 12=Prog Set Update via communication port)	1
1388 - 1388	5001 - 5001	Reserved - do not use.					1
1389 - 138A	5002 - 5003	Time Since Reset	UINT32	0 to 4294967294	4 msec	wraps around after max count	2
						Block Size:	4
Commands Section[4]							
Resets Block[3]						write-only	
4E1F - 4E1F	20000 - 20000	Reset Max/Min Blocks	UINT16	password[5]			1
4E20 - 4E20	20001 - 20001	Reset Energy Accumulators	UINT16	password[5]			1
						Block Size:	2
Meter Programming Block						read/conditional write	
55EF - 55EF	22000 - 22000	Initiate Programmable Settings Update	UINT16	password[5]		meter enters PS update mode	1
55F0 - 55F0	22001 - 22001	Terminate Programmable Settings Update[3]	UINT16	any value		meter leaves PS update mode via reset	1
55F1 - 55F1	22002 - 22002	Calculate Programmable Settings Checksum[3]	UINT16			meter calculates checksum on RAM copy of PS block	1
55F2 - 55F2	22003 - 22003	Programmable Settings Checksum[3]	UINT16			read/write checksum register; PS block saved in EEPROM on write[8]	1
55F3 - 55F3	22004 - 22004	Write New Password[3]	UINT16	0000 to 9999		write-only register; always reads zero	1
59D7 - 59D7	23000 - 23000	Initiate Meter Firmware Reprogramming	UINT16	password[5]			1
						Block Size:	6
Other Commands Block						read/write	
61A7 - 61A7	25000 - 25000	Force Meter Restart	UINT16	password[5]		causes a watchdog reset, always reads 0	1
						Block Size:	1

Modbus Address							
Hex	Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
Encryption Block						read/write	
658F - 659A	26000 - 26011	Perform a Secure Operation	UINT16			encrypted command to read password or change meter type	12
						Block Size:	12

Programmable Settings Section

Basic Setups Block						write only in PS update mode	
752F - 752F	30000 - 30000	CT multiplier & denominator	UINT16	bit-mapped	ddddddddd mmmmmmmm	high byte is denominator (5, read-only), low byte is multiplier (1, 10, or 100)	1
7530 - 7530	30001 - 30001	CT numerator	UINT16	1 to 9999	none		1
7531 - 7531	30002 - 30002	PT numerator	UINT16	1 to 9999	none		1
7532 - 7532	30003 - 30003	PT denominator	UINT16	1 to 9999	none		1
7533 - 7533	30004 - 30004	PT multiplier & hookup	UINT16	bit-mapped	mmmmmmmm MMMMhhhh	MMMMmmmmmmmm is PT multiplier (1, 10, 100, 1000), hhhh is hookup enumeration (0 = 3 element wye[9S], 1 = delta 2 CTs[5S], 3 = 2.5 element wye[6S])	1
7534 - 7534	30005 - 30005	Averaging Method	UINT16	bit-mapped	--iiiiii b----sss	iiiii = interval (5,15,30,60) b = 0-block or 1-rolling sss = # subintervals (1,2,3,4)	1
7535 - 7535	30006 - 30006	Power & Energy Format	UINT16	bit-mapped	pppp--nn -eee-ddd	pppp = power scale (0-unit, 3-kilo, 6-mega, 8-auto) nn = number of energy digits (5-8 --> 0-3) eee = energy scale (0-unit, 3-kilo, 6-mega) ddd = energy digits after decimal point (0-6) See note 10.	1
7536 - 7536	30007 - 30007	Operating Mode Screen Enables	UINT16	bit-mapped	00000000 eeeeeeee	eeeeeeee = op mode screen rows on(1) or off(0), rows top to bottom are bits low order to high order	1
7537 - 753D	30008 - 30014	Reserved - do not use.					7

Modbus Address							
Hex	Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
753E - 753E	30015 - 30015	User Settings Flags	UINT16	bit-mapped	---g--nn srp--wf-	g = enable alternate full scale bargraph current (1=on, 0=off) nn = number of phases for voltage & current screens (3=ABC, 2=AB, 1=A, 0=ABC) s = scroll (1=on, 0=off) r = password for reset in use (1=on, 0=off) p = password for configuration in use (1=on, 0=off) w = pwr dir (0-view as load, 1-view as generator) f = flip power factor sign (1=yes, 0=no)	1
753F - 753F	30016 - 30016	Full Scale Current (for load % bargraph)	UINT16	0 to 9999	none	If non-zero and user settings bit g is set, this value replaces CT numerator in the full scale current calculation.	1
7540 - 7547	30017 - 30024	Meter Designation	ASCII	16 char	none		8
7548 - 7548	30025 - 30025	Reserved - do not use.					1
7549 - 7549	30026 - 30026	Communication port setup	UINT16	bit-mapped	----dddd -ppp-bbb	dddd = reply delay (* 50 msec) ppp = protocol (1-Modbus RTU, 2-Modbus ASCII) bbb = baud rate (1-9600, 2-19200, 4-38400, 6-57600)	1
754A - 754A	30027 - 30027	Communication port address	UINT16	1 to 247	none		1
754B - 754B	30028 - 30028	Reserved - do not use.					1
754C - 754C	30029 - 30029	Reserved - do not use.					1

Modbus Address							
Hex	Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
754D - 754D	30030 - 30030	Reserved - do not use.					1
754E - 754E	30031 - 30031	Reserved - do not use.					1
754F - 754F	30032 - 30032	Reserved - do not use.					1
7550 - 7554	30033 - 30037	Reserved - do not use.					5
7555 - 7559	30038 - 30042	Reserved - do not use.					5
755A - 755E	30043 - 30047	Reserved - do not use.					5
755F - 7563	30048 - 30052	Reserved - do not use.					5
7564 - 7568	30053 - 30057	Reserved - do not use.					5
7569 - 756D	30058 - 30062	Reserved - do not use.					5
756E - 7572	30063 - 30067	Reserved - do not use.					5
						Block Size:	68
Secondary Readings Section							
Secondary Block						read-only except as noted	
9C40 - 9C40	40001 - 40001	System Sanity Indicator	UINT16	0 or 1	none	0 indicates proper meter operation	1
9C41 - 9C41	40002 - 40002	Volts A-N	UINT16	2047 to 4095	volts	2047= 0, 4095= +150	1
9C42 - 9C42	40003 - 40003	Volts B-N	UINT16	2047 to 4095	volts	volts = 150 * (register - 2047) / 2047	1
9C43 - 9C43	40004 - 40004	Volts C-N	UINT16	2047 to 4095	volts		1
9C44 - 9C44	40005 - 40005	Amps A	UINT16	0 to 4095	amps	0= -10, 2047= 0, 4095= +10	1
9C45 - 9C45	40006 - 40006	Amps B	UINT16	0 to 4095	amps	amps = 10 * (register - 2047) / 2047	1
9C46 - 9C46	40007 - 40007	Amps C	UINT16	0 to 4095	amps		1
9C47 - 9C47	40008 - 40008	Watts, 3-Ph total	UINT16	0 to 4095	watts	0= -3000, 2047= 0, 4095= +3000	1
9C48 - 9C48	40009 - 40009	VARs, 3-Ph total	UINT16	0 to 4095	VARs	watts, VARs, VAs = 3000 * (register - 2047) / 2047	1
9C49 - 9C49	40010 - 40010	VAs, 3-Ph total	UINT16	2047 to 4095	VAs		1
9C4A - 9C4A	40011 - 40011	Power Factor, 3-Ph total	UINT16	1047 to 3047	none	1047= -1, 2047= 0, 3047= +1 pf = (register - 2047) / 1000	1
9C4B - 9C4B	40012 - 40012	Frequency	UINT16	0 to 2730	Hz	0= 45 or less, 2047= 60, 2730= 65 or more freq = 45 + ((register / 4095) * 30)	1
9C4C - 9C4C	40013 - 40013	Volts A-B	UINT16	2047 to 4095	volts	2047= 0, 4095= +300	1
9C4D - 9C4D	40014 - 40014	Volts B-C	UINT16	2047 to 4095	volts	volts = 300 * (register - 2047) / 2047	1
9C4E - 9C4E	40015 - 40015	Volts C-A	UINT16	2047 to 4095	volts		1
9C4F - 9C4F	40016 - 40016	CT numerator	UINT16	1 to 9999	none	CT = numerator * multiplier / denominator	1
9C50 - 9C50	40017 - 40017	CT multiplier	UINT16	1, 10, 100	none		1
9C51 - 9C51	40018 - 40018	CT denominator	UINT16	5	none		1
9C52 - 9C52	40019 - 40019	PT numerator	UINT16	1 to 9999	none	PT = numerator * multiplier / denominator	1
9C53 - 9C53	40020 - 40020	PT multiplier	UINT16	1, 10, 100	none		1
9C54 - 9C54	40021 - 40021	PT denominator	UINT16	1 to 9999	none		1

Modbus Address							
Hex	Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
9C55 - 9C56	40022 - 40023	W-hours, Positive	UINT32	0 to 99999999	Wh per energy format	* 5 to 8 digits	2
9C57 - 9C58	40024 - 40025	W-hours, Negative	UINT32	0 to 99999999	Wh per energy format	* decimal point implied, per energy format	2
9C59 - 9C5A	40026 - 40027	VAR-hours, Positive	UINT32	0 to 99999999	VARh per energy format	* resolution of digit before decimal point = units, kilo, or mega, per energy format	2
9C5B - 9C5C	40028 - 40029	VAR-hours, Negative	UINT32	0 to 99999999	VARh per energy format		2
9C5D - 9C5E	40030 - 40031	VA-hours	UINT32	0 to 99999999	VAh per energy format	* see note 10	2
9C5F - 9C5F	40032 - 40032	Neutral Current	UINT16	0 to 4095	amps	see Amps A/B/C above	1
9C60 - 9CA2	40033 - 40099	Reserved - do not use.					67
9CA3 - 9CA3	40100 - 40100	Reset Energy Accumulators	UINT16	password[5]		write-only register; always reads as 0	1
						Block Size:	100

End of Map

Data Formats

ASCII	ASCII characters packed 2 per register in high, low order and without any termination characters. For example, "Shark50" would be 4 registers containing 0x5368, 0x6172, 0x6B35, 0x3020.
SINT16 / UINT16	16-bit signed / unsigned integer.
SINT32 / UINT32	32-bit signed / unsigned integer spanning 2 registers. The lower-addressed register is the high order half
FLOAT	32-bit IEEE floating point number spanning 2 registers. The lower-addressed register is the high order half (i.e., contains the exponent

Notes

1	All registers not explicitly listed in the table read as 0. Writes to these registers will be accepted but won't actually change the register (since it doesn't exis
2	Meter Data Section items read as 0 until first readings are available or if the meter is not in operating mode. Writes to these registers will be accepted but won't actually change the regist
3	Register valid only in programmable settings update mode. In other modes these registers read as 0 and return an illegal data address exception if a write is attempte
4	Meter command registers always read as 0. They may be written only when the meter is in a suitable mode. The registers return an illegal data address exception if a write is attempted in an incorrect mode.
5	If the password is incorrect, a valid response is returned but the command is not executed. Use 5555 for the password if passwords are disabled in the programmable settings.
6	M denotes a 1,000,000 multiplier.
7	Not applicable to Shark 50.
8	Writing this register causes data to be saved permanently in EEPROM. If there is an error while saving, a slave device failure exception is returned and programmable settings mode automatically terminates via reset.
9	Reset commands make no sense if the meter state is LIMP. An illegal function exception will be returned.
10	Energy registers should be reset after a format change.
11	Not applicable to Shark 50.
12	Not applicable to Shark 50.
13	Not applicable to Shark 50.
14	All 3 voltage angles are measured for Wye and Delta hookups. For 2.5 Element, Vac is measured and Vab & Vbc are calculated. If a voltage phase is missing, the two voltage angles in which it participates are set to zero. A and C phase current angles are measured for all hookups. B phase current angle is measured for Wye and is zero for other hookups. If a voltage phase is missing, its current angle is zero.
15	If any register in the programmable settings section is set to a value other than the acceptable value then the meter will stay in LIMP mode. Please read the comments section or the range for each register in the programmable settings section for acceptable settings.
16	Not applicable to Shark 50.

C: Shark® 100 Meter DNP Map

C.1: Introduction

The Shark® 100 meter's DNP map shows the client-server relationship in the meter's use of DNP Protocol.

C.2: DNP Mapping (DNP-1 to DNP-2)

The Shark® 100 DNP Point Map follows.

Binary Output States, Control Relay Outputs, Binary Counters (Primary) and Analog Inputs are described on page DNP-1.

Internal Indication is described on page DNP-2.

This page intentionally left blank.

Object	Point	Var	Description	Format	Range	Multiplier	Units	Comments
Binary Output States								Read via Class 0 only
10	0	2	Reset Energy Counters	BYTE	Always 1	N/A	none	
10	1	2	Change to Modbus RTU Protocol	BYTE	Always 1	N/A	none	
Control Relay Outputs								
12	0	1	Reset Energy Counters	N/A	N/A	N/A	none	Responds to Function 5 (Direct Operate), Qualifier Code 17x or 28x, Control Code 3, Count 0, On 0 msec, Off 1 msec ONLY.
12	1	1	Change to Modbus RTU Protocol	N/A	N/A	N/A	none	Responds to Function 6 (Direct Operate - No Ack), Qualifier Code 17x, Control Code 3, Count 0, On 0 msec, Off 1 msec ONLY.
Binary Counters (Primary)								Read via Class 0 only
20	0	4	W-hours, Positive	UINT32	0 to 99999999	multiplier = $10^{(n-d)}$, where n and d are derived from the energy format. n = 0, 3, or 6 per energy format scale and d = number of decimal places.	W hr	example: energy format = 7.2K and W-hours counter = 1234567 n=3 (K scale), d=2 (2 digits after decimal point), multiplier = $10^{(3-2)} = 10^1 = 10$, so energy is 1234567 * 10 Whrs, or 12345.67 KWhrs
20	1	4	W-hours, Negative	UINT32	0 to 99999999		W hr	
20	2	4	VAR-hours, Positive	UINT32	0 to 99999999		VAR hr	
20	3	4	VAR-hours, Negative	UINT32	0 to 99999999		VAR hr	
20	4	4	VA-hours, Total	UINT32	0 to 99999999		VA hr	
Analog Inputs (Secondary)								Read via Class 0 only
30	0	5	Meter Health	SINT16	0 or 1	N/A	none	0 = OK
30	1	5	Volts A-N	SINT16	0 to 32767	(150 / 32768)	V	Values above 150V secondary read 32767.
30	2	5	Volts B-N	SINT16	0 to 32767	(150 / 32768)	V	
30	3	5	Volts C-N	SINT16	0 to 32767	(150 / 32768)	V	
30	4	5	Volts A-B	SINT16	0 to 32767	(300 / 32768)	V	Values above 300V secondary read 32767.
30	5	5	Volts B-C	SINT16	0 to 32767	(300 / 32768)	V	
30	6	5	Volts C-A	SINT16	0 to 32767	(300 / 32768)	V	
30	7	5	Amps A	SINT16	0 to 32767	(10 / 32768)	A	Values above 10A secondary read 32767.
30	8	5	Amps B	SINT16	0 to 32767	(10 / 32768)	A	
30	9	5	Amps C	SINT16	0 to 32767	(10 / 32768)	A	

Object	Point	Var	Description	Format	Range	Multiplier	Units	Comments
30	10	5	Watts, 3-Ph total	SINT16	-32768 to +32767	(4500 / 32768)	W	
30	11	5	VARs, 3-Ph total	SINT16	-32768 to +32767	(4500 / 32768)	VAR	
30	12	5	VAs, 3-Ph total	SINT16	0 to +32767	(4500 / 32768)	VA	
30	13	5	Power Factor, 3-Ph total	SINT16	-1000 to +1000	0.001	none	
30	14	5	Frequency	SINT16	0 to 9999	0.01	Hz	
30	15	5	Positive Watts, 3-Ph, Maximum Avg Demand	SINT16	-32768 to +32767	(4500 / 32768)	W	
30	16	5	Positive VARs, 3-Ph, Maximum Avg Demand	SINT16	-32768 to +32767	(4500 / 32768)	VAR	
30	17	5	Negative Watts, 3-Ph, Maximum Avg Demand	SINT16	-32768 to +32767	(4500 / 32768)	W	
30	18	5	Negative VARs, 3-Ph, Maximum Avg Demand	SINT16	-32768 to +32767	(4500 / 32768)	VAR	
30	19	5	VAs, 3-Ph, Maximum Avg Demand	SINT16	-32768 to +32767	(4500 / 32768)	VA	
30	20	5	Angle, Phase A Current	SINT16	-1800 to +1800	0.1	degree	
30	21	5	Angle, Phase B Current	SINT16	-1800 to +1800	0.1	degree	
30	22	5	Angle, Phase C Current	SINT16	-1800 to +1800	0.1	degree	
30	23	5	Angle, Volts A-B	SINT16	-1800 to +1800	0.1	degree	
30	24	5	Angle, Volts B-C	SINT16	-1800 to +1800	0.1	degree	
30	25	5	Angle, Volts C-A	SINT16	-1800 to +1800	0.1	degree	
30	26	5	CT numerator	SINT16	1 to 9999	N/A	none	CT ratio = (numerator * multiplier) / denominator
30	27	5	CT multiplier	SINT16	1, 10, or 100	N/A	none	
30	28	5	CT denominator	SINT16	1 or 5	N/A	none	
30	29	5	PT numerator	SINT16	1 to 9999	N/A	none	PT ratio = (numerator * multiplier) / denominator
30	30	5	PT multiplier	SINT16	1, 10, or 100	N/A	none	
30	31	5	PT denominator	SINT16	1 to 9999	N/A	none	
30	32	5	Neutral Current	SINT16	0 to 32767	(10 / 32768)	A	For 1A model, multiplier is (2 / 32768) and values above 2A secondary read 32767.
Internal Indication								
80	0	1	Device Restart Bit	N/A	N/A	N/A	none	Clear via Function 2 (Write), Qualifier Code 0.

D: DNP 3.0 Protocol Assignments

DNP 3.0 protocol is available in the Shark® 100 meter if the meter is a V3 or V4 optioned unit. The meter must also be equipped with an RS485 port. The Shark® 100 meter does not support DNP over Ethernet - only Modbus over Ethernet is available.

D.1: DNP Implementation

PHYSICAL LAYER

The Shark® 100 meter can use RS485 as the physical layer. This is accomplished by connecting a PC to the meter using the meter's RS485 connection (see Chapter 5).

RS485

RS485 provides multi-drop network communication capabilities. Multiple meters can be placed on the same bus, allowing for a Master device to communicate with any of the other devices. Appropriate network configuration and termination should be evaluated for each installation to insure optimal performance (see Chapter 5).

Communication Parameters

Shark® 100 meters communicate in DNP 3.0 using the following communication settings:

- 8 Data Bits
- No Parity
- 1 Stop Bit
- Baud Rates: 9600, 19200, 38400, 57600

D.2: Data Link Layer

The Data Link Layer for Shark® 100 meters is subject to the following considerations:

Control Field

The Control Byte contains several bits and a Function Code.

Control Bits

Communication directed to the meter should be Primary Master messages (DIR = 1, PRM = 1). Response will be primary Non-Master messages (DIR = 0, PRM = 1). Acknowledgment will be Secondary Non-Master messages (DIR = 0, PRM = 0).

Function Codes

Shark® 100 meters support all of the Function Codes for DNP 3.0.

Reset of Data Link (Function 0)

Before confirmed communication with a master device, the Data Link Layer must be reset. This is necessary after a meter has been restarted, either by applying power to the meter or reprogramming the meter. The meter must receive a RESET command before confirmed communication can take place. Unconfirmed communication is always possible and does not require a RESET.

User Data (Function 3)

After receiving a request for USER DATA, the meter generates a Data Link CONFIRMATION, signaling the reception of the request, before the actual request is processed. If a response is required, it is also sent as UNCONFIRMED USER DATA.

Unconfirmed User Data (Function 4)

After receiving a request for UNCONFIRMED USER DATA, if a response is required, it is sent as UNCONFIRMED USER DATA.

Address

DNP 3.0 allows for addresses from 0 - 65534 (0x0000 - 0xFFFE) for individual device identification, with the address 65535 (0xFFFF) defined as an all stations address. Shark® 100 meters' addresses are programmable from 0 - 247 (0x0000 - 0x00F7), and address 65535 (0xFFFF) is recognized as the all stations address.

D.3: Transport Layer

The Transport Layer as implemented on Shark® 100 meters is subject to the following considerations:

Transport Header

Multiple-frame messages are not allowed for Shark® 100 meters. Each Transport Header should indicate it is both the first frame (FIR = 1) as well as the final frame (FIN = 1).

D.4: Application Layer

The Application Layer contains a header (Request or Response Header, depending on direction) and data.

Application Headers

Application Headers contain the Application Control Field and the Function Code.

Application Control Field

Multiple-fragment messages are not allowed for Shark® 100 meters. Each Application Header should indicate it is both the first fragment (FIR = 1) as well as the final fragment (FIN = 1). Application-Level confirmation is not used by Shark® 100 meters.

Function Codes

The following Function codes are implemented on Shark® 100 meters.

Read (Function 1)

Objects supporting the READ function are:

- Binary Outputs (Object 10)
- Counters (Object 20)
- Analog Inputs (Object 30)
- Class (Object 60)

These Objects can be read either by requesting a specific Variation available as listed in this appendix, or by requesting Variation 0. READ requests for Variation 0 of an Object is fulfilled with the Variation listed in this appendix.

Write (Function 2)

Objects supporting the WRITE function are:

- Internal Indications (Object 80)

Direct Operate (Function 5)

Objects supporting the DIRECT OPERATE function are:

- Control Relay Output Block (Object 12)

Direct Operate - No Acknowledgment (Function 6)

Objects supporting the DIRECT OPERATE - NO ACKNOWLEDGMENT function are:

- Change to MODBUS RTU Protocol

Response (Function 129)

Application responses from Shark® 100 meters use the RESPONSE function.

Application Data

Application Data contains information about the Object and Variation, as well as the Qualifier and Range.

D.4.1: Object and Variation

The following Objects (Obj.) and Variations (Var.) are supported by Shark® 100 meters:

- Binary Output Status (Object 10, Variation 2) †
- Control Relay Output Block (Object 12, Variation 1)
- 32-Bit Binary Counter Without Flag (Object 20, Variation 5) †
- 16-Bit Analog Input Without Flag (Object 30, Variation 4) †

- Class 0 Data (Object 60, Variation 1) †
- Internal Indications (Object 80, Variation 1)

† READ requests for Variation 0 are honored with the above Variations.

D.4.1.1: Binary Output Status (Obj. 10, Var. 2)

Binary Output Status supports the following function:

Read (Function 1)

A READ request for Variation 0 is responded to with Variation 2.

Binary Output Status is used to communicate the following data measured by Shark® 100 meters:

Energy Reset State

Change to MODBUS RTU Protocol State

Energy Reset State (Point 0)

Shark® 100 meters accumulate power generated or consumed over time as Hour Readings, which measure positive VA Hours and positive and negative W Hours and VAR Hours. These readings can be reset using a Control Relay Output Block object (Object 12). The Binary Output Status point reports whether the Energy Readings are in the process of being reset, or are accumulating. Normally, readings are being accumulated - the state of this point reads as '0'. If readings are in the process of being reset, the state of this point reads as '1'.

Change to Modbus RTU Protocol State (Point 1)

Shark® 100 meters can of change from DNP Protocol to Modbus RTU Protocol. This enables the user to update the Device Profile of the meter (this does not change the meter's Protocol setting). A meter reset brings communication back to DNP. A status reading of "1" equals Open, or de-energized. A reading of "0" equals Closed, or energized.

D.4.1.2: Control Relay Output Block (Obj. 12, Var. 1)

Control Relay Output Block supports the following functions:

Direct Operate (Function 5)

Direct Operate - No Acknowledgment (Function 6)

Control Relay Output Blocks are used for the following purposes:

Energy Reset

Change to MODBUS RTU Protocol

Energy Reset (Point 0)

As stated previously, Shark® 100 meters accumulate power generated or consumed over time as Hour Readings, which measure positive VA Hours and positive and negative W Hours and VAR Hours. These readings may be reset using Point 0.

Change to Modbus RTU Protocol (Point 1)

Refer to Section D.4.1.1 on the previous page for the Change to Modbus Protocol information.

Use of the DIRECT OPERATE (Function 5) function will operate only with the settings of Pulsed ON (Code = 1 of Control Code Field) once (Count = 0x01) for ON 1 millisecond and OFF 0 milliseconds.

D.4.1.3: 32-Bit Binary Counter Without Flag (Obj. 20, Var. 5)

Counters support the following functions:

Read (Function 1)

A READ request for Variation 0 is responded to with Variation 5.

Counters are used to communicate the following data measured by Shark® 100 meters:

Hour Readings

Hour Readings (Points 0 - 4)

Point	Readings	Unit
0	+W hour	Wh
1	-W hour	Wh
2	+VAR hour	VARh
3	-VAR hour	VARh
4	+VA hour	VAh

NOTE: These readings may be cleared by using the Control Relay Output Block (see previous Section D.4.1.2).

D.4.1.4: 16-Bit Analog Input Without Flag (Obj. 30, Var. 4)

Analog Inputs support the following functions:

Read (Function 1)

A READ request for Variation 0 is responded to with Variation 4.

Analog Inputs are used to communicate the following data measured by Shark® 100 meters:

- Health Check
- Phase-to-Neutral Voltage
- Phase-to-Phase Voltage

- Phase Current
- Total Power
- Three Phase Total VAs
- Three Phase Power Factor Total
- Frequency
- Three Phase +Watts Max Avg Demand
- Three Phase + VARs Max Avg Demand
- Three Phase -Watts Max Avg Demand
- Three Phase -VARs Max Avg Demand
- Three Phase VAs Max Avg Demand
- Angle, Phase Power
- Angle, Phase-to-Phase Voltage
- CT Numerator, Multiplier, Denominator
- PT Numerator, Multiplier, Denominator

Health Check (Point 0)

The Health Check point is used to indicate problems detected by the Shark® 100 meter. A value of zero (0x0000) indicates the meter does not detect a problem. Non-zero values indicate a detected anomaly.

Phase-to-Neutral Voltage (Points 1 - 3)

Point	Reading
1	Phase AN Voltage
2	Phase BN Voltage
3	Phase CN Voltage

These points are formatted as 2's complement fractions. They represent a fraction of a 150V Secondary input. Inputs of above 150V Secondary are pinned at 150V Secondary.

Phase-to-Phase Voltage (Points 4 - 6)

Point	Reading
4	Phase AB Voltage
5	Phase BC Voltage
6	Phase CA Voltage

These points are formatted as 2's complement fractions. They represent a fraction of a 300V Secondary input. Inputs of above 30 V Secondary are pinned at 300V Secondary.

Phase Current (Points 7 - 9)

Point	Reading
7	Phase A Current
8	Phase B Current
9	Phase C Current

These points are formatted as 2's complement fractions. They represent a fraction of a 10A Secondary input. Inputs of above 10A Secondary are pinned at 10A Secondary.

Total Power (Points 10 - 11)

Point	Reading
10	Total Watt
11	Total VAR

These points are formatted as 2's complement fractions. They represent a fraction of 4500W Secondary in normal operation, or 3000W Secondary in Open Delta operation. Inputs above/below +/-4500 or +/-3000W Secondary are pinned at +/-4500 or +/-3000W Secondary, respectively.

Total VA (Point 12)

Point	Reading
12	Total VA

This point is formatted as a 2's complement fraction. It represents a fraction of 4500W Secondary in normal operation, or 3000W Secondary in Open Delta operation. Inputs above/below +/-4500 or +/-3000W Secondary are pinned at +/-4500 or +/-3000W Secondary, respectively.

Power Factor (Point 13)

Point	Reading
13	Power Factor Total

This point is formatted as a 2's complement integer. It represents Power Factors from -1.000 (0x0FC18) to +1.000 (0x003E8). In Open Delta operation, Total Power Factor (Point 13) is always zero.

Frequency (Point 14)

Point	Reading
14	Frequency

This point is formatted as a 2's complement fraction. It represents the Frequency as measured on Phase A Voltage in units of cHz (centiHertz, 1/100 Hz). Inputs below 45.00 Hz are pinned at 0 (0x0000); inputs above 75.00 Hz are pinned at 9999 (0x270F).

Maximum Demands of Total Power (Points 15 - 19)

Point	Reading
15	Maximum Positive Demand Total Watts
16	Maximum Positive Demand Total VARs
17	Maximum Negative Demand Total Watts
18	Maximum Negative Demand Total VARs
19	Maximum Average Demand VAs

These points are formatted as 2's complement fractions. They represent a fraction of 4500W Secondary in normal operation, or 3000W Secondary in Open Delta operation. Inputs above/below +/-4500 or +/-3000W Secondary are pinned at +/-4500 or +/-3000W Secondary, respectively.

Phase Angle (Points 20 - 25)

Point	Reading
20	Phase A Current Angle
21	Phase B Current Angle
22	Phase C Current Angle
23	Volts A-B Angle
24	Volts B-C Angle
25	Volts C-A Angle

These points are formatted as 2's complement integers. They represent angles from -180.00 (0x0F8F8) to +180.00 (0x00708).

CT & PT Ratios (Points 26 - 31)

Point	Reading
26	CT Ratio Numerator
27	CT Ratio Multiplier
28	CT Ratio Denominator
29	PT Ratio Numerator
30	PT Ratio Multiplier
31	PT Ratio Denominator

These points are formatted as 2's complement integers. They can be used to convert from units in terms of the Secondary of a CT or PT into units in terms of the Primary of a CT or PT. The ratio of Numerator divided by Denominator is the ratio of Primary to Secondary.

Shark® 100 meters typically use full scales relating primary current to 5 A and primary voltage to 120 V. However, these Full scales can range from mAs to thousands of kAs, and from mVs, to thousands of kVs. Following are example settings:

CT Example Settings

200 amps: Set the Ct-n value for 200 and the Ct-S value for 1.

800 amps: Set the Ct-n value for 800 and the Ct-S value for 1.

2,000 amps: Set the Ct-n value for 2000 and the Ct-S value for 1.

10,000 amps:Set the Ct-n value for 1000 and the Ct-S value for 10.

NOTE: CT Denominator is fixed at 5 for 5 A units; CT Denominator is fixed at 1 for 1 A units.

PT Example Settings

277 volts (Reads 277 volts): Pt-n value is 277, Pt-d value is 277, Pt-S value is 1.

120 volts (Reads 14,400 volts): Pt-n value is 1440, Pt-d value is 120, Pt-S value is 10.

69 volts (Reads 138,000 volts): Pt-n value is 1380, Pt-d value is 69, Pt-S value is 100.

115 volts (Reads 347,000 volts): Pt-n value is 3470, Pt-d value is 115, Pt-S value is 100.

69 volts (Reads 347,000 volts): Pt-n value is 347, Pt-d value is 69, Pt-S value is 1000.

D.4.1.5: Class 0 Data (Obj. 60, Var. 1)

Class 0 Data supports the following functions:

Read (Function 1)

A request for Class 0 Data from a Shark® 100 meter returns three Object Headers. Specifically, it returns 16-Bit Analog Input Without Flags (Object 30, Variation 4), Points 0 - 31, followed by 32-Bit Counters Without Flags (Object 20, Variation 5), Points 0 - 4, followed by Binary Output Status (Object 10, Variation 2), Points 0 - 1. (There is NO Object 1.)

A request for Object 60, Variation 0 is treated as a request for Class 0 Data.

D.4.1.6: Internal Indications (Obj. 80, Var. 1)

Internal Indications support the following functions:

Write (Function 2)

Internal Indications may be indexed by Qualifier Code 0.

Device Restart (Point 0)

This bit is set whenever the meter resets. The polling device may clear this bit by Writing (Function 2) to Object 80, Point 0.

This page intentionally left blank.

E: Using the USB to IrDA Adapter CAB6490

E.1: Introduction

Com 1 of the Shark® 100 meter is the IrDA port, located on the face of the meter. One way to communicate with the IrDA port is with EIG's USB to IrDA Adapter CAB6490, which allows you to access the Shark® meter's data from a PC. This Appendix contains instructions for installing the USB to IrDA Adapter.

E.2: Installation Procedures

The USB to IrDA Adapter comes packaged with a USB cable and an Installation CD. Follow this procedure to install the Adapter on your PC.

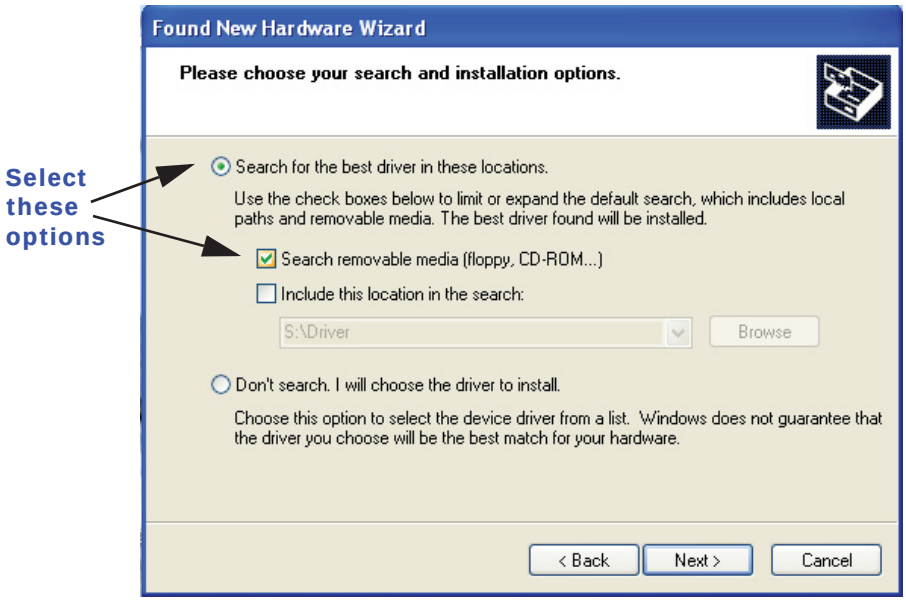
1. Connect the USB cable to the USB to IrDA Adapter, and plug the USB into your PC's USB port.

2. Insert the Installation CD into your PC's CD ROM drive.

3. You will see the screen shown below. The Found New Hardware Wizard allows you to install the software for the Adapter. Click the Radio Button next to **Install from a list or specific location**.

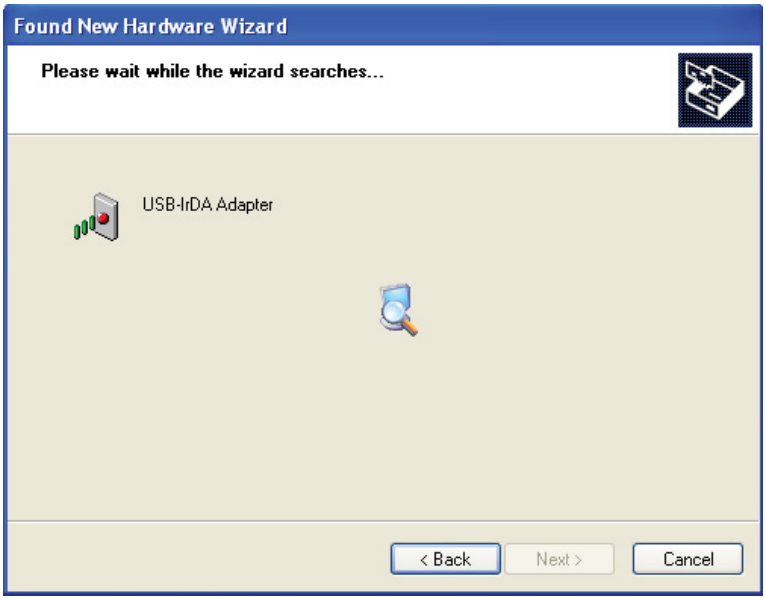
Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
This wizard helps you install software for:
USB-IrDA Adapter
If your hardware came with an installation CD or floppy disk, insert it now.
What do you want the wizard to do?
Install the software automatically (Recommended)
Install from a list or specific location (Advanced)
Click Next to continue.
< Back
Next >
Cancel

4. Click **Next**. You will see the screen shown on the next page.

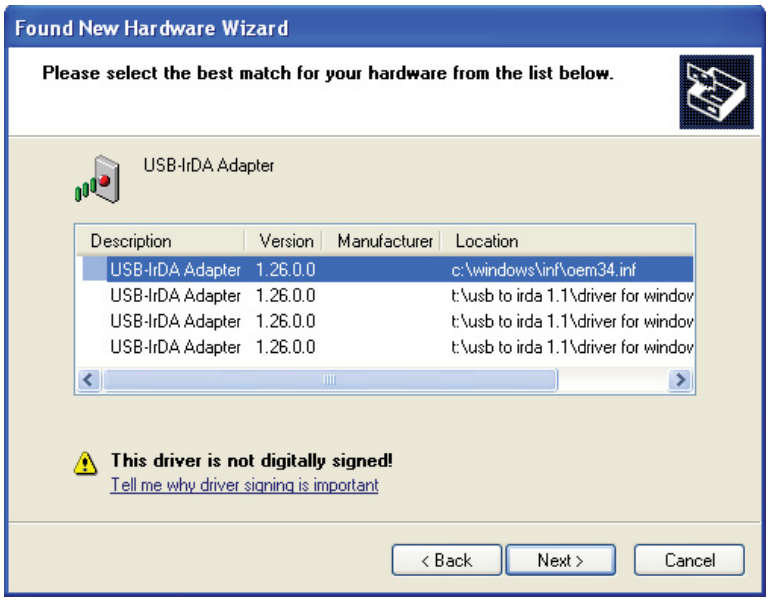

Found New Hardware Wizard
Please choose your search and installation options.
Select these options
Search for the best driver in these locations.
Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.
Search removable media (floppy, CD-ROM...)
Include this location in the search:
S:\Driver
Browse
Don't search. I will choose the driver to install.
Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.
< Back
Next >
Cancel

5. Make sure the first Radio Button and the first Checkbox are selected, as shown above. These selections allow the Adapter's driver to be copied from the Installation disk to your PC.

6. Click **Next**. You will see the screen shown below.

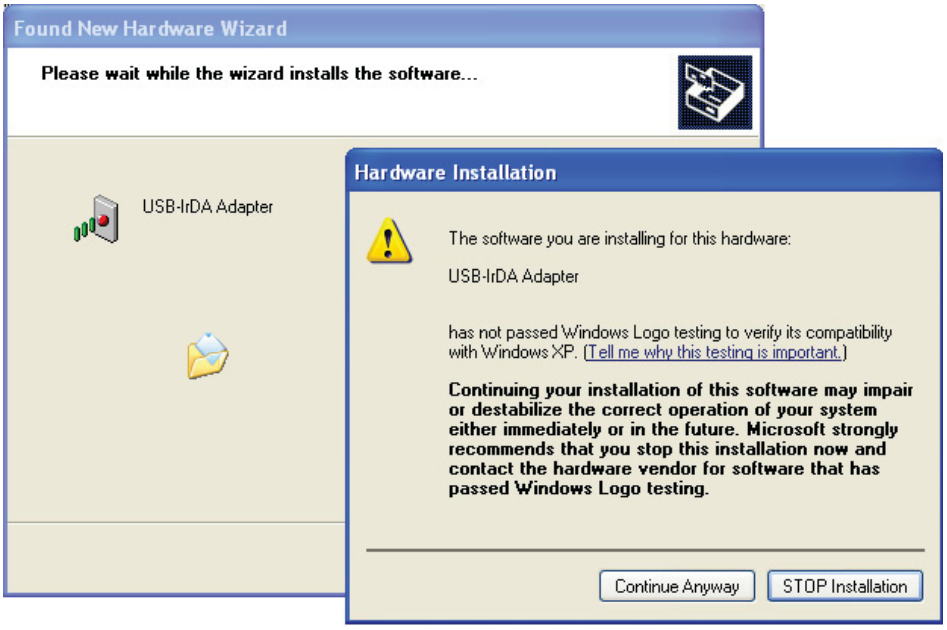


7. When the driver for the Adapter is found, you will see the screen shown on the next page.

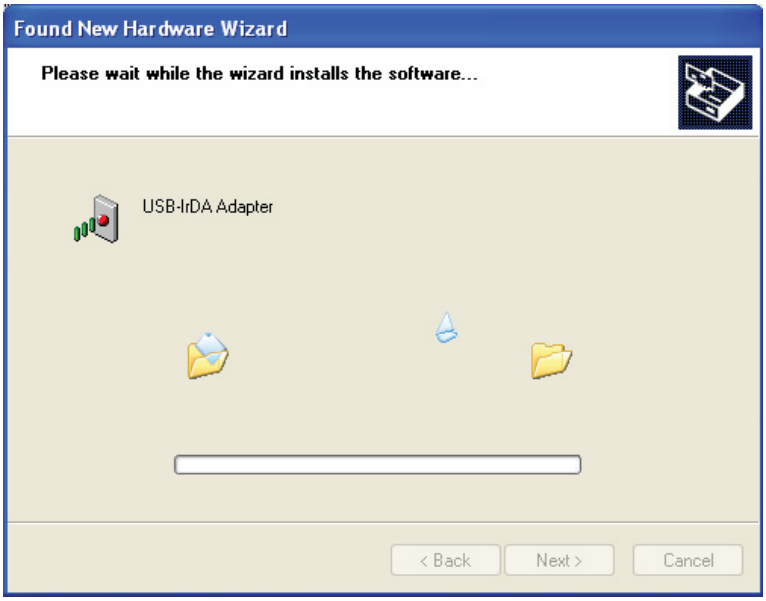

Found New Hardware Wizard
Please select the best match for your hardware from the list below.
USB-IrDA Adapter
Description
Version
Manufacturer
Location
USB-IrDA Adapter 1.26.0.0 c:\windows\inf\oem34.inf
USB-IrDA Adapter 1.26.0.0 t:\usb to irda 1.1\driver for windov
USB-IrDA Adapter 1.26.0.0 t:\usb to irda 1.1\driver for windov
USB-IrDA Adapter 1.26.0.0 t:\usb to irda 1.1\driver for windov
This driver is not digitally signed!
Tell me why driver signing is important
< Back
Next >
Cancel

8. You do not need to be concerned about the message on the bottom of the screen. Click **Next** to continue with the installation.

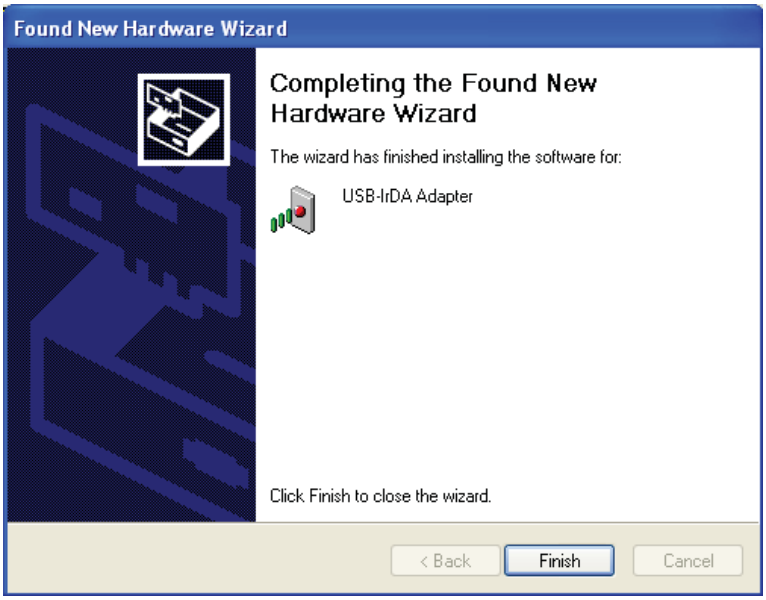
9. You will see the two windows shown below. Click **Continue Anyway**.


Found New Hardware Wizard
Please wait while the wizard installs the software...
USB-IrDA Adapter
Hardware Installation
The software you are installing for this hardware:
USB-IrDA Adapter
has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)
Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing.
Continue Anyway
STOP Installation

10. You will see the screen shown below while the Adapter's driver is being installed on your PC.



11. When driver installation is complete, you will see the screen shown below.



12. Click **Finish** to close the Found New Hardware Wizard.

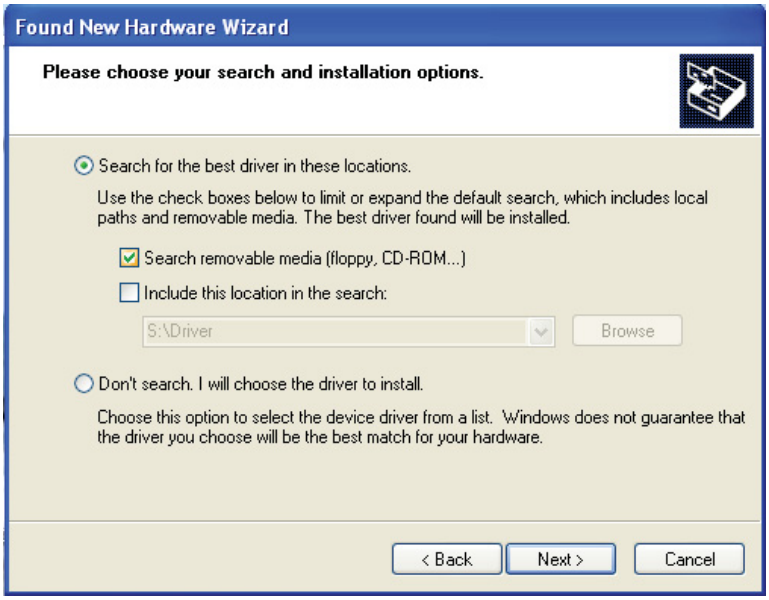
IMPORTANT! Do NOT remove the Installation CD until the entire procedure has been completed.

13. Position the USB to IrDA Adapter so that it points directly at the IrDA on the front of the Shark® 100 meter. It should be as close as possible to the meter, and not more than 15 inches/38 cm away from it.

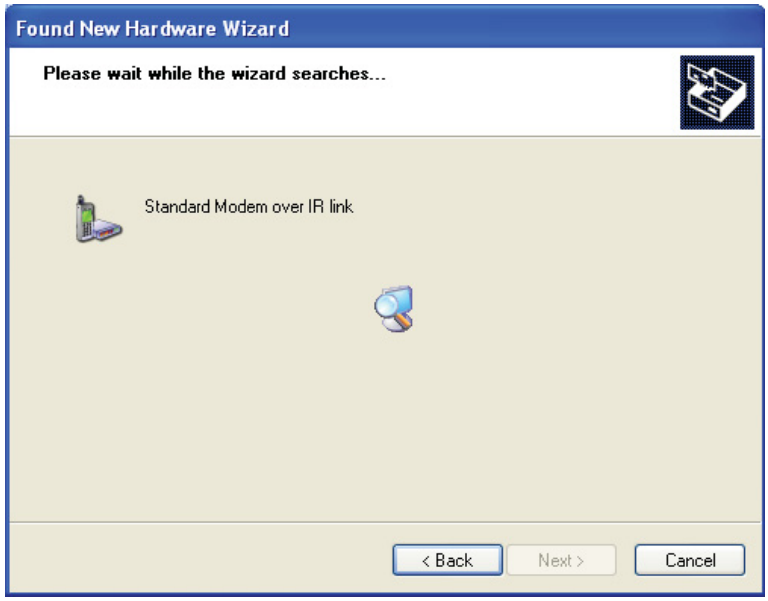
14. The Found New Hardware Wizard screen opens again. This time, click the Radio Button next to Install the software automatically.

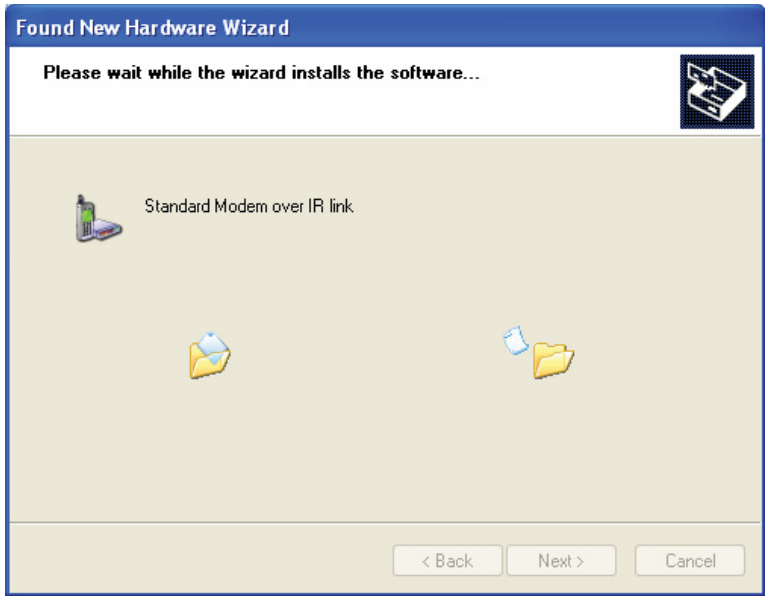
Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
This wizard helps you install software for:
USB-IrDA Adapter
If your hardware came with an installation CD or floppy disk, insert it now.
What do you want the wizard to do?
Install the software automatically (Recommended)
Install from a list or specific location (Advanced)
Click Next to continue.
< Back
Next >
Cancel

15. Click **Next**. You will see the screen shown below.

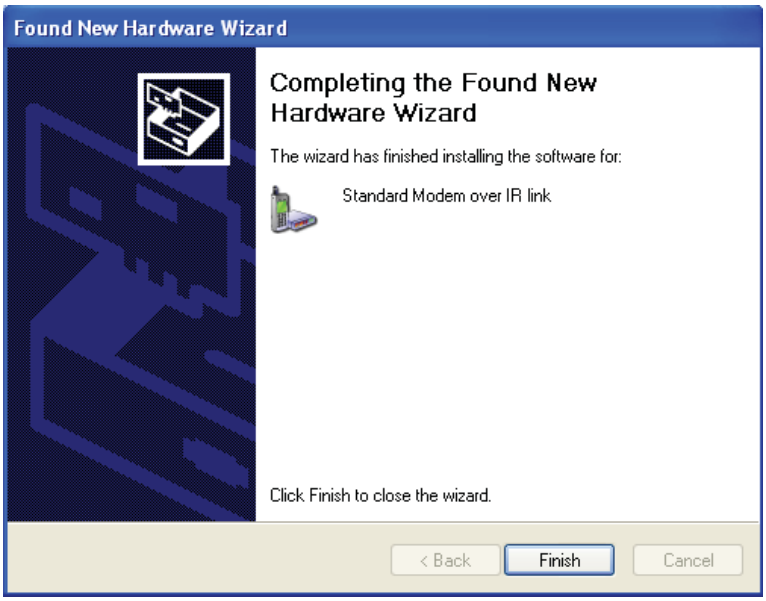

Found New Hardware Wizard
Please choose your search and installation options.
Search for the best driver in these locations.
Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.
Search removable media (floppy, CD-ROM...)
Include this location in the search:
S:\Driver
Browse
Don't search. I will choose the driver to install.
Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.
< Back
Next >
Cancel

16. Make sure the first Radio Button and the first Checkbox are selected, as shown above screen. Click **Next**. You will see the two screens shown on the next page.


Found New Hardware Wizard
Please wait while the wizard searches...
Standard Modem over IR link
< Back
Next >
Cancel


Found New Hardware Wizard
Please wait while the wizard installs the software...
Standard Modem over IR link
< Back
Next >
Cancel

17.When installation is complete, you will see the screen shown below.

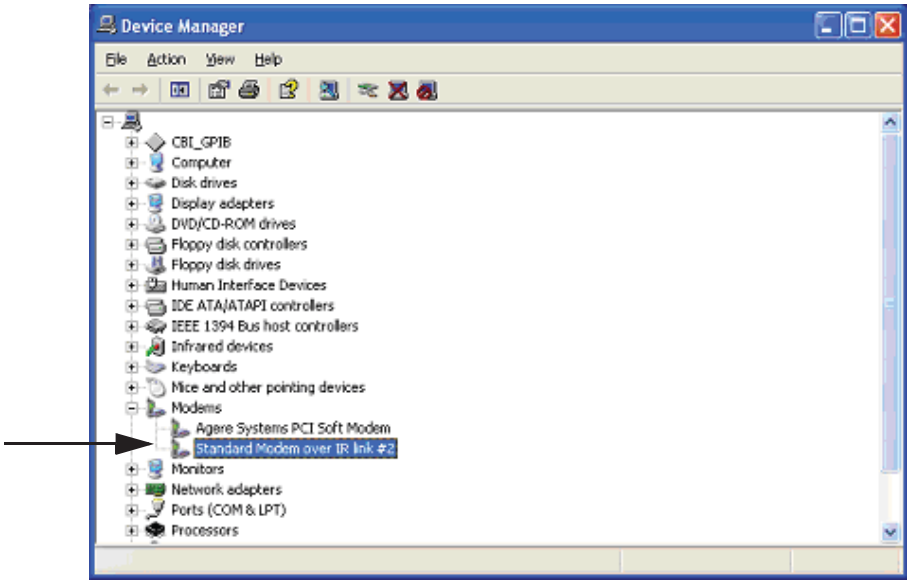

Found New Hardware Wizard
Completing the Found New Hardware Wizard
The wizard has finished installing the software for:
Standard Modem over IR link
Click Finish to close the wizard.
< Back
Finish
Cancel

18.Click **Finish** to close the Found New Hardware Wizard.

To verify that your Adapter has been installed properly:

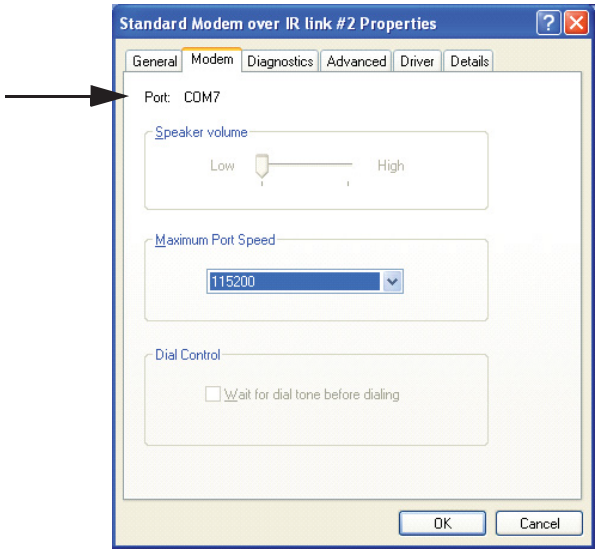
1. Click **Start>Settings>Control Panel>System>Hardware>Device Manager**. The USB to IrDA Adapter should appear under both Infrared Devices and Modems (click on the + sign to display all configured modems). See the example screen below.

NOTE: If the Adapter doesn't show up under Modems, move it away from the meter for a minute and then position it pointing at the IrDA, again.



2. Double-click on the Standard Modem over IR link (this is the USB to IrDA Adapter). You will see the Properties screen for the Adapter.

3. Click the Modem tab. The Com Port that the Adapter is using is displayed in the screen.



4. Use this Com Port to connect to the meter from your PC, using the Communicator EXT™ software. Refer to Chapter 9 of the *Communicator EXT™ 4.0 and MeterManager EXT Software User Manual* for detailed connection instructions.